

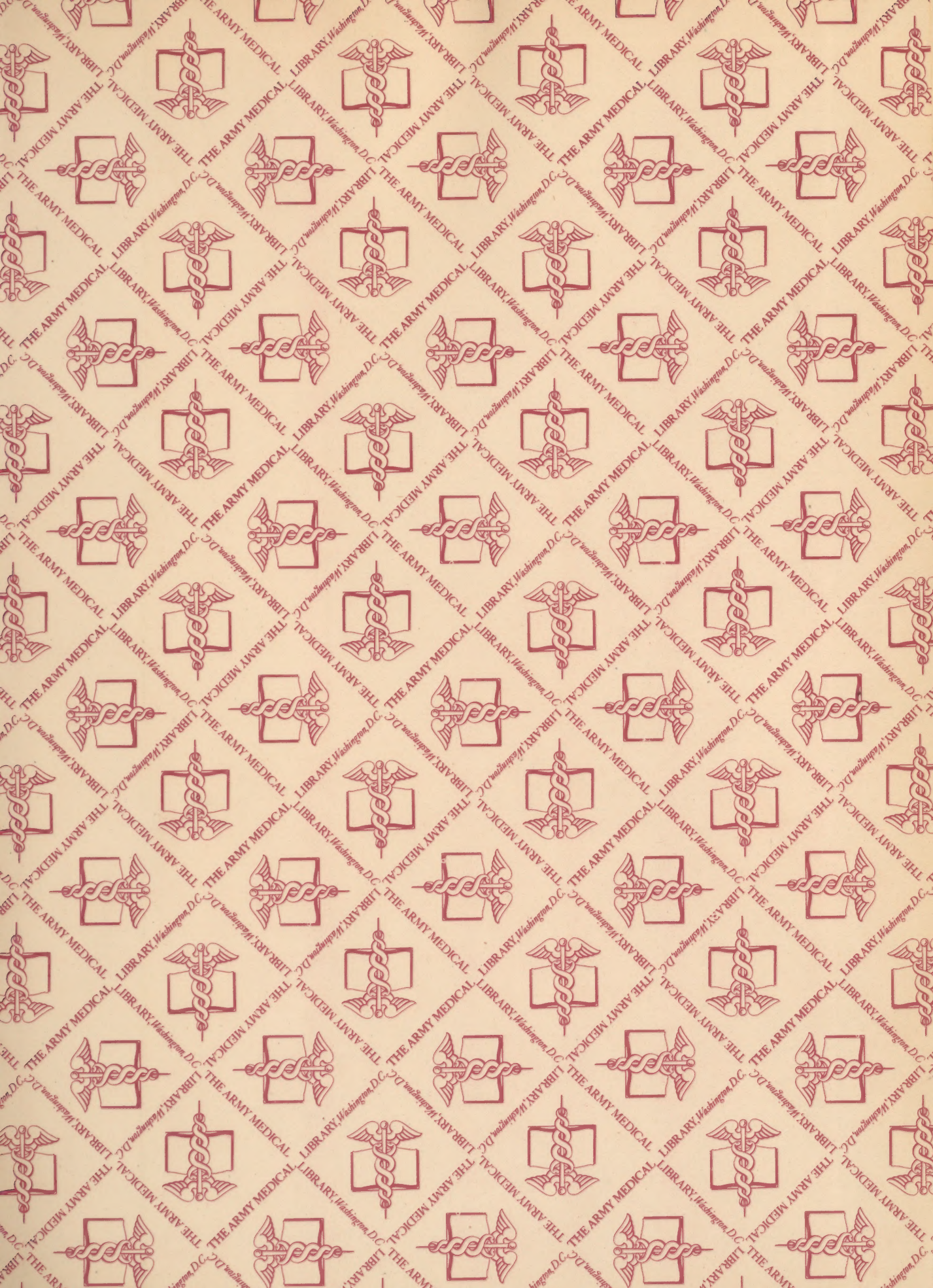


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PHARMACY - GALENICAL
For Pharmacy Technicians
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GALENICAL PHARMACY

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HEAT

1. DEFINITION - HEAT has been defined as a force generated by molecular motion; the manifestation of one form of molecular motion; or the force which overcomes molecular cohesion. It is generally accepted that all bodies have more or less molecular motion; the greater the motion, the greater will be the heat. Heat causes molecules to pass through a longer distance and in doing so it tends to overcome cohesion. Heat may be transferred into other forms of energy, as light and electricity.
2. CHANGES EFFECTED BY HEAT - Solids may be changed to liquids by heat, and liquids to gases, or solids may be changed at once to gases. Bodies change in size as the temperature changes, generally increasing with heat and diminishing with cold. Liquids change less regularly than gases, and solids less regularly than liquids. Substances are generally more bulky in the liquid state than in the solid condition. Water is a good example of an exception to this statement. It expands when it freezes and, because of this expansion, it floats instead of sinking. It has its greatest density at 4° centigrade and expands as the temperature goes either up or down.
3. SOURCES and APPARATUS for HEAT - It will be convenient to consider the various practical operations and appliances for generating heat under four heads:
 - a. Operations and forms of apparatus in which solids are used in developing heat.
 - (1) We are not concerned with the solid fuels in the army pharmacy. The solid fuels include charcoal, coal, coke.
 - b. Those in which liquids are used.
 - (1) The liquids which are most used in pharmaceutical operations for heating are ethyl alcohol, denatured alcohol, methanol, petroleum or coal oil and petroleum benzin or gasoline.
 - (a) Alcohol burns with a blue flame, which does not deposit soot, and the heat produced is intense. It is in many respects the best liquid fuel for generating heat in small operations.
 - (b) Methanol has nearly all the advantages of alcohol when used for burning in lamps, and it is much cheaper than pure ethyl alcohol. It should, however, never be used as a solvent in pharmaceutical preparations, as it is very poisonous when taken internally and is dangerous even when applied externally or when inhaled; too much caution cannot be exercised to guard against its improper use. In burning alcohol, a glass spirit lamp, provided with a ground glass cap may be used. The cap prevents loss of alcohol by evaporation from the wick, when the lamp is not in use.
 - (c) Petroleum benzin, or gasoline, is now used for heating purposes. The difficulties in the use of the very inflammable and often dangerous liquids of this class for heating have been largely overcome. To avoid a smoky luminous flame the vapor is burned after being mixed with air, while to prevent

explosion the reservoir for the liquid is elevated and placed some distance away from the ignited vapor. The vapor only is burned, the gasoline being volatilized by the heat from the metal burner. It produces a blue and intensely hot flame, the size of which may be easily regulated.

(d) Kerosene or coal oil is so widely known as a refined petroleum product, that any extended notice of its properties would be superfluous; as it is heavier in specific gravity and has a much higher flashing and firing point than gasoline, it is much safer for proper use.

c. Operations and forms of apparatus in which gases are used in developing heat.

(1) Gas - The extensive employment of manufactured illuminating gas and natural gas as sources of heat for pharmaceutical and other purposes, rendering necessary a somewhat extended notice of gas in this connection. The high carbon monoxide content of the water gas and the flue gas account for a toxic character of these two gases. Death from coal gas is due to mechanical suffocation, whereas death from water gas or flue gas is due to a distinct physiological poison, namely the carbon monoxide, which robs the blood of its oxygen carrying power, so essential to the continuation of life. The odor of manufactured gas is usually a sufficient warning of a leak, and natural gas, which is frequently odorless, is given an odor, usually by the addition of sulphur compounds, to render it safer for domestic consumption.

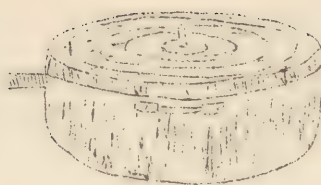
(a) Bunsen Burners - Gas which is fitted for illuminating purposes must have its composition modified by admixture with air before it is fit for heating purposes. For this reason Bunsen burners which are more frequently used in simple operations using gas, were devised. The gas issues from a small orifice, near the base, passes up through a brass tube, about 4" high, and is ignited at the top of this tube; large circular openings surround the small orifice at the base, and these may be closed either wholly or in part by a perforated brass ring; this permits the regulation of the supply of air, which mixes with the gas as it ascends the tube, and a blue, smokeless, intensely hot flame may be produced. If the perforated ring is turned so that the air openings are closed, a luminous, smoky flame results. One of the objections to the ordinary Bunsen burner is that, after being used for a time under a low gas pressure, when the tube becomes hot the flame will sometimes recede and the gas becomes ignited at the lower orifice. This may usually be avoided by gradually turning the brass perforated ring, so as to admit less air to suit the diminished pressure.

d. Electricity as a source of heat. The utilization of electricity as a source of light has naturally turned the minds of inventors to devising means of using it for heating purposes. In many localities it will often be found that for convenience, cleanliness, and the ease of application electric stoves have an advantage. The current flows through fine wires of highly resisting metal and the heat produced by the resistance warms the top plate of the stove. The heat may be regulated to "high," "medium," or "low," or may be turned off completely through the use of a switch operated by a button.

4. BATHS - Baths in pharmacy are devised for uniform distribution or for the limitation of heat. Thus the heat of a Bunsen burner, while very satisfactory, is apt to be more intense on one portion of the utensil being heated than on another, and to this cause is due most of the fractures on heating glass and porcelain utensils.



Spirit lamp
for alcohol.



Water Bath



Evaporating Dish



Bunsen Burner
For Gas.

It is a dictum that, in heating substances in porcelain or ordinary glass utensils, the direct heat of a Bunsen burner should never be applied, but the flame should be uniformly distributed in the several ways at our disposals. The simplest form for the uniform distribution of heat is a sheet of asbestos or of tin, by which the cylindric flame of a Bunsen burner is spread after the entire surface of the interposing medium, and a uniform heat is in turn transmitted from it to the container above.

a. Wire Gauze - Far more convenient than these, however, is a piece of gauze made of iron or copper wire. Through such gauze the heat more readily penetrates than through asbestos, and at the same time the heat is as uniformly distributed by reason of the fact that the wire of which the gauze is constructed is an admirable conductor of heat, and the moment the flame comes in contact with the gauze, each of its many filaments aid in drawing the heat to every portion of the gauze. This has the effect of chilling the flame itself, hence such flame cannot pass through a wire gauze until the gauze has become heated to a temperature almost equal to the flame.

b. Sand-baths - A sand-bath consists of a suitable flat dish, usually made of sheet iron, in which is put a sufficient quantity of fine clean sand to make a layer of about $\frac{1}{2}$ inch, the container of the liquid to be evaporated is placed therein, and the sand is piled around so as to completely surround it. Heat by means of a Bunsen burner or other flame is applied under the dish, and is uniformly transmitted to all portions of the heating substance. In this form of bath the heat is limited only to the amount produced by the burner, the sole aim being to distribute the heat uniformly.

c. Liquid Baths - These consist of a suitable dish containing the liquid which is to be heated, the heat of which is in turn transmitted to the substance which it is desired to make hot. The liquids used for this purpose are oil, glycerin, salt water, and water.

(1) The oil-baths, like the sand bath, uniformly transmits heat, but in addition thereto limits the amount of heat by reason of the fact that when

the temperature of 260° centigrade is attained, the oil begins to burn; that is, undergoes decomposition, with the formation of the stifling vapors of acrolein, which serves as a warning to the operator that a high heat has been attained.

(2) Glycerin baths act on the same principal of operation as the oil-bath, and are limited for the same reason 250° centigrade. Both forms of bath are, not so much used now, by reason of the fact that they do not really limit heat, and a method of warning to the operator is too disagreeable to be popular. In their place, liquid petrolatum is used as the heating fluid.

(3) A salt-water bath is based on the same principal as the water-bath, say that it consists of an aqueous solution of some salt whereby the temperature of the boiling liquid is raised.

(4) Water-Baths - In these the liquid to be used is water, and since water boils at a 100° centigrade the temperature of the bath never rises above that point. There is comparatively little necessity for buying expensive apparatus for use as a water-bath. Any tin pail filled with water in which the evaporating dish can be rested, or into which the flask can be sunk, can be used.

5. APPLICATIONS OF HEAT - Following are some of the operations in which heat is used: vaporization, evaporation, boiling, distillation, sublimation, desiccation, exsiccation, torrefaction, incineration, carbonization, calcination, fusion, digestion, deflagration.

a. Vaporization is a conversion of a volatile substance into a vapor or gaseous condition. When the solid is heated sufficiently so that the expansive force of heat equals the cohesive force of the molecules, a liquid is formed. If the expansive force of the heat exceeds the pressure of the atmosphere, the liquid changes to a vapor.

b. Evaporation means to pass off in a vapor, escape in the air and be dissipated. The primary purpose of this operation is to remove water, alcohol, or other solvent from non-volatile substances in order that the solute may be prepared in greater concentration or in dry form. Factors that hasten evaporation are:

(1) The use of a shallow evaporating dish which exposes a larger surface of the substance to be evaporated.

(2) Constant stirring which brings fresh material to the surface.

(3) The use of sufficient heat.

"Bumping" which is common in boiling alkaline solutions, and which is always troublesome, is due to the sudden liberation of large bubbles of gas at the bottom of the vessel. It can frequently be reduced by having insoluble angular objects, as broken glass, or broken porcelain, or pieces of pumice stone in the liquid, or by forcing air through it.

c. Distillation is the separation of a volatile liquid from one or more associated liquids by vaporization and condensation by virtue of their different boiling points. The equipment usually used in the process of distillation is a

flask, a condenser and a receiver. The flask contains a substance and is heated to vaporize the liquid, the vapors rise to the neck of the flask, and pass through the side tube and into a condenser which condenses the vapor into liquid form; the receiver collects the distillate (condensate). "Bumping" of a liquid during distillation may be so severe as to carry some of the liquid over into the condenser and receiver, which condition can generally be avoided as explained in paragraph 5, b. above.

(1) Steam Distillation. Many volatile organic substances require such a high temperature when distilled in the ordinary way that they may be injured, but can readily be volatilized with steam. For this purpose live steam may be conducted into a flask containing the substance to be distilled.

(2) Fractional Distillation. In analytical and other work it is frequently necessary to separate a composite liquid into its several components. This is accomplished by fractional distillation. The distilling flask is provided with a thermometer whose bulb is on a level with the side tube. Heat is applied to the flask, the temperature noted as the vapor enters the side tube, and the distillation continued as long as the temperature of the vapor remains approximately constant. As soon as the latter rises, an empty receiver is substituted for the first one. This procedure is continued until practically the entire liquid has been distilled.

(3) Destructive Distillation is applied to organic substances; it is incomplete combustion and is carried on in an oven or other enclosure to which but little air is admitted, causing decomposition of the substance heated. Provision is made for the condensation of any volatile substances.

(4) Rectification is the purification of volatile substances by distillation. It is used frequently in pharmacy for the purification of alcohol.

d. Sublimation is the volatilization of a solid and subsequent condensation of the vapor. Sublimation on a small scale can be carried out with very simple equipment. The material is ground or mixed with sand, placed in a small flask with a short neck which is passed through a hole in a box. The flask is carefully heated to volatilize the material and the vapors pass into the box whose temperature is much lower than that of the flask, and the material condenses. Iodine may be sublimed by heating in a small evaporating dish over which a funnel is inverted. The latter being cooler than the dish, serves as a condenser.

e. Fusion is the melting of a solid by the application of heat which converts it into a fluid and is applied to solid fats, waxes, etc. for the purpose of mixing them intimately with other substances.

f. Desiccation is the removal of moisture of water not chemically combined with a substance by exposing the substance to a dry atmosphere at ordinary temperature or by placing them in drying ovens which are maintained at a temperature high enough to remove the moisture rapidly but not so high as to injure them. A desiccator is a closed vessel containing sulphuric acid, calcium chloride, lime, or some other substance which has a strong affinity for water. In the desiccator are put crucibles and articles that have been heated when it is desired that they should not absorb moisture on cooling, or articles that are

to be dried at ordinary temperature.

g. Exsiccation is generally applied in cases where a high heat is used, high enough to drive off "water of crystallization". Examples of exsiccation are found in dried alum or dried sodium phosphate. In exsiccating a salt which has a large amount of water of crystallization, it should be allowed to effloresce in the air at ordinary temperature for a time, otherwise the heat may liberate water of crystallization in sufficient amount to liquefy the salt and then it is very difficult to dry and when dried the salt will be in a mass or in hard granules, not in a soft smooth powder as it should be.

h. Torrefaction is the roasting of organic substances. The heat must not be so intense as to char the substance; generally, however, there is a darkening

i. Carbonization is the heating of a substance to incomplete combustion in a chamber to which but little air is admitted, until it is completely charred and only carbon plus inorganic constituents (charcoal) is left.

j. Calcination is the application of a rather high degree of heat to inorganic chemical substances to drive out some volatile components. Magnesium carbonate when calcined loses carbon dioxide and magnesium oxide is left.

k. Ignition or incineration is the application of a temperature high enough to burn all combustible matter, leaving nothing but the inorganic ash.

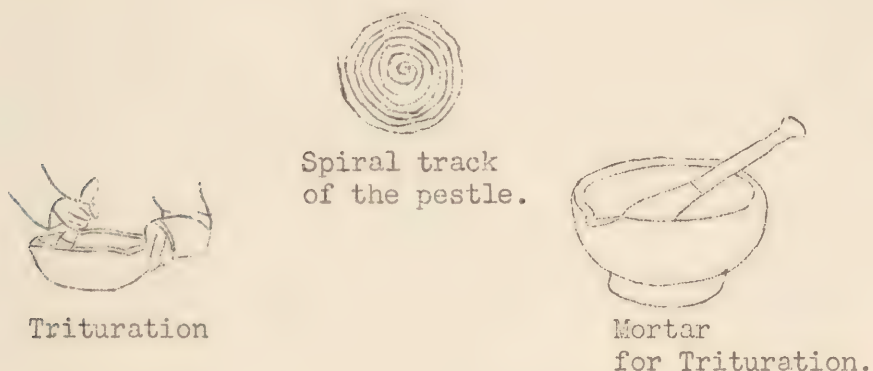
6. DEFINITION - COMMINATION is the reduction of any substance to small particles or a powder. The object of this treatment may be to aid drying, for preservation, or to facilitate handling; but most generally it is to aid solution or extraction. A comminuted substance exposes a much greater surface to the solvent; consequently the solution of a chemical will result more quickly or a vegetable drug will be extracted much better. A simple illustration is offered in the case of alu. The solid lump of alum weighing one ounce, when added to a pint of water, will not dissolve nearly so quickly as will one ounce of the same alum in fine powder in the same quantity of water. The several processes used are slicing, contusing, rasping, grating, grinding, powdering, triturating, and levigating. Except on a small scale the pharmacy technician is not called upon to perform any of these.

7. a. PROCESSES - We are not concerned with cutting, slicing, chopping or rasping in the army pharmacy. Grating is used very little except for the preparation of lemon peel or orange peel in the preparation of the respective tinctures. For this process a convenient apparatus to use is the grater listed in Class VII, Mess Equipment and Supplies, of the Medical Department Supply Catalog.

b. Contusion is breaking or crushing a drug by beating or pounding it with the use of a heavy mortar and a heavy pestle.

c. Trituration is the process of reducing substances to fine particles by rubbing them in a mortar with a pestle. It is also used to designate the process by which substances in fine powder may be intimately mixed. The pestle is given a circular motion, accompanied by downward pressure. The most effective method of using the pestle is to begin in the center of the mortar and describe a circle of small diameter with the pestle on the substance, and gradu-

ally increase the size of the circle with each revolution until the side of the mortar is touched, when the motion is reversed and circles continuing smaller in diameter are described until the center is reached. The powder is frequently scraped from the sides of the mortar and pestle by the use of a spatula and the trituration repeated until pulverization is effected. By this treatment all the particles are brought under the action of the pestle. Crystals and chemicals can generally be quite readily powdered, but with certain compounds it is easier if a volatile solvent is used in just sufficient amount to dampen it, as in powdering camphor with alcohol or iodoform with ether. Some drugs give trouble by becoming electrified, as oil of theobroma, resin or acetanilid; dampening with a volatile liquid overcomes the difficulty.



(1) Mortars are most commonly made of earthenware known as Wedgewood, sometimes of porcelain or glass. Glass is objectionable because it is so smooth and easily broken. Failure often results in attempting to make an emulsion in a glass mortar, because the mixture slips around. Porcelain mortars are more expensive than Wedgewood but for many things are more suitable. They do not absorb odors and are not easily stained. The solid or one piece pestle is very satisfactory but care must be taken, because they break very easily when dropped. Wedgewood mortars, after long usage become smooth but can be roughened by triturating with sharp sand. With the wooden handled, Wedgewood tipped pestle, the handle often becomes loose, and the cement and materials are likely to get into the substance being triturated. The handles can be fastened in again by warming the tip and cementing with a mixture of rosin, and beeswax. The solid porcelain pestles can be used with the Wedgewood mortar. The convex surface of the head of the pestle should have a slightly smaller curvature than that of the concave surface of the mortar.

d. Levigation is the process of reducing an inorganic substance to an impalpable powder by rubbing it while moist with a liquid in which it is not soluble. This is generally done in a mortar.

e. "Elutriation" is carried out by mixing an insoluble powder with water, allowing the coarser and heavier particles to subside and decanting a part of the water carrying the fine material in suspension into another vessel. The latter is then dried and sifted.

SOLUTION

8. DEFINITION - A chemically and physically homogeneous mixture of two or more substances is said to be a solution. Originally, the term solution was limited to homogeneous mixtures which are liquid but the present and broader interpretation of the term includes also homogeneous mixtures which are solid or gaseous. Thus, it is possible to have solutions of solids in liquids, liquids in liquids, gases in liquid, gases in gases, solids in solids, and certain scientific authorities also recognize solutions of gases in solids and of liquids in solids. However, only the first three are of pharmaceutical importance.

a. In discussing solutions, it is customary to consider them as belonging to a certain class of dispersions of one substance in another substance. Depending upon the size of the dispersed particles we recognize true solutions, colloidal solutions, and suspensions. If sugar is dissolved in water, it is supposed that the ultimate sugar particle is of molecular dimensions and that a true solution is formed. On the other hand, if fine sand is mixed with water, a suspension of comparatively large particles, each consisting of many molecules is obtained. Between these two extremes lie colloidal solutions, which differ from true solutions in being dispersions of larger particles and which differ from suspensions in being dispersions of smaller particles.

b. A solvent is a substance capable of, or used in, dissolving something.

c. A solute is a dissolved substance.

d. A solution is composed of a solvent and a solute and is said to be saturated when the solvent has dissolved as much of any solute as can be retained in solution under normal conditions of temperature and pressure.

e. A super-saturated solution is one in which, under certain conditions, the liquid is made to hold in solution more of the substance than it will do ordinarily. A hot saturated solution of certain salts, as magnesium sulfate, if allowed to cool without any disturbance, may retain the salts in solution at ordinary temperature, but if it is disturbed the salts will at once crystallize out, and in crystallizing quickly, heat is imparted to the mixture, because latent heat is changed to active. Other salts from which super-saturated solutions are readily made are sodium sulfate, sodium thio-sulphate and the alums.

f. Two kinds of solutions are generally recognized. They are:

(1) Simple Solutions.

In simple solutions the agent dissolved and the solvent do not lose their chemical properties, and can be separated into the same conditions as they were before being mixed, as salt in

water. The solution has a salty taste but no solid salt can be seen even with the highest powered microscope known at the present time. In making a simple solution, as of ammonium chloride in water, the temperature is reduced.

(2) Chemical Solutions.

By chemical solution (sometimes called complex solution) is meant a solution in which chemical reaction takes place; the substance dissolved and the solvent form a new compound, as iron dissolved in hydro-chloric acid gives chloride of iron. The ferrous chloride has different properties from either iron or hydrochloric acid. Chemical reaction causes the solution to become warm. A chemical solution is sometimes referred to as a compound solution; but, more properly speaking, a compound solution is solution of several ingredients, as compound solution of cresol.

g. A solution may be made by mixing a solid (as sugar), a liquid, (as glycerin), or a gas (as hydrochloric acid) with a liquid (as water). Or it may be made by mixing two solids (as menthol and camphor). When two solids liquefy on being brought together the mixture is known as eutectic one and corresponds to an alloy of metal. Either solid may be said to be dissolved in the other, just as in the case of two liquids, one may be said to be dissolved in the other. Also for example alloys such as brass are considered solutions of the metals of which they are composed.

h. Aids to Solution.

(1) Solution is aided by having the solid in the form of a fine powder, because the surface exposed to the solvent is much greater. Scale salts of iron are better not powdered, as they are liable to gum up and make a mass which dissolves slowly.

(2) Agitation aids solution by bringing a less saturated liquid in contact with the substance.

(3) Heat generally aids solution, perhaps to some extent by separating the molecules farther apart, and by keeping the liquid in motion. Heat is not always allowable, as it may injure the active agent. A few compounds, as some of the calcium salts are less soluble in hot water than in cold. Sodium sulphate is most soluble at a temperature of about 34° C. Common salt dissolves in 2.8 parts of cold water and 2.7 parts of boiling water. However, if a gas is to be dissolved in a liquid, as carbon dioxide in water, cold and pressure increase the amount dissolved.

(4) Circulatory Solution or displacement is performed by suspending the substance to be extracted in a bag or basket in the upper part of the solvent. As the matter dissolves out, the liquid becomes heavier, sinks to the bottom, and less saturated liquid takes its place. This process is of particular service as dissolving such agents as iodine, acacia, and camphor, and in making infusions.

(5) Rapidity of solution varies with the agents and with

the solvents. A compound may be very soluble but dissolves slowly or it may dissolve quickly but not be very soluble. The presence of one compound in solution may have an effect on the solubility of another. Potassium iodide greatly increases the solubility of iodine in water. Adding sodium chloride in sufficient amount to a solution of pepsin throws the pepsin out of solution. A strong solution of chloral hydrate dissolves starch.

i. Classification of Solvents.

(1) Water - The most useful of all solvents is water. It has a more extensive range of solvent action than any other liquid, and the aqueous solutions are among the most important preparations of pharmacy. They are especially treated in later sections, under the head of solutions, waters, syrups, etc. Water is also the best solvent known for most inorganic salts. As a diluting medium for other solvents with which it is miscible, as alcohol, glycerin, and etc., water is indispensable in many preparations.

(2) Alcohol - Alcohol as a solvent is next in importance to water. It has an important advantage over water in the fact that preparations made with it keep almost indefinitely, while most aqueous solutions of organic substances soon decompose or become worthless. Resins, volatile oils, alkaloids, glucosides and etc., are dissolved by alcohol while many inert principles, like albumin, and starch are insoluble in it so that it has also great usefulness in its negative character. Mixtures of water and alcohol, in proportions varying to suit specific cases, are exceedingly common. They are often referred to as hydro-alcoholic solvents or menstrua.

(3) Glycerin - Glycerin is an excellent solvent, although its range is not so extensive as either of the preceding. It has in its concentrated state preservative qualities of a high order, but has not the valuable negative qualities of alcohol. It dissolves the fixed alkalies, a great number of neutral salts, and vegetable acids, pepsin, tannin, and some other active principles of plants, etc., but it also dissolves gum, soluble carbohydrates, starch, and etc., and thus its solutions are generally loaded with inert constituents. It is also of special value as a simple solvent, as in glycerite of phenol or where the major portion of the glycerin is simply added as a preservative and stabilizer of solutions that have been prepared with other solvents. (See Glycerites)

(4) Ether - Ether is a good solvent for special purposes. Oils, fats, resins, and some of the alkaloids and neutral principles are dissolved by it. It is one of the solvents used in making oleo-resins.

(5) Petroleum Benzin - Petroleum Benzin is very similar in its solvent properties to ether. It is frequently used in pharmacy to remove and inert and objectionable fatty and waxy constituents from such drugs as opium, digitalis, strophanthus, and etc., prior to extracting the active principles with hydro-alcoholic menstruum.

(6) Chloroform - Chloroform resembles ether and petroleum benzin as a solvent. It has an advantage over both, however, in not being inflammable.

(7) Carbon-disulfid - Carbon disulfid is an excellent solvent for rubber, phosphorous, etc. Its range is limited, however, and its odor and inflammability detract from its usefulness.

(8) Carbon Tetrachloride - Carbon Tetrachloride is a valuable non-inflammable solvent of fats, oils, etc.

(9) Acetone. - Acetone is not an immiscible solvent, but it is midway between alcohol and ether in its solvent action. It was used officially as a solvent for extracting and preparing oleoresins but has been replaced by ether for this purpose for economic reasons.

(10) Acids. - Acids are employed in dilute solutions as solvents for alkaloids and usually convert them into readily soluble salts of the alkaloids.

(11) Alkalies. - Alkalies solutions are sometimes used as solvents for special cases.

(12) Oils. - Fixed oils are used as solvents in liniments and other preparations.

(13) Immiscible Solvents. - Immiscible Solvents are those that will not mix one with another, as water and chloroform.

j. Modes of Effecting Solutions of Solids. The method usually employed by the pharmacist when a chemical salt is to be dissolved in water in compounding a prescription is one which requires the use of the solution mortar and pestle. The ordinary practice is to crush the substance into fragments in the mortar with the pestle, and then pour the solvent upon it, meanwhile stirring it with the pestle until solution is effected. If definite quantities are used, and the whole of the solvent is required to dissolve the given weight of the salts, a portion only of the solvent should be added at first, and when this is saturated the solution is poured off and a fresh portion of solvent is added. The operation is repeated until the solid is entirely dissolved; the solutions are then mixed. Other methods of effecting solutions are to shake the solid with the liquid in a bottle or flask, or to apply heat to the substances in a suitable vessel. With hygroscopic compounds like pepsin, scaled iron salts, argyrol, and some others, the best method of effecting solution in water is to pour the substance directly upon the surface of the water in which the solution is to be effected, and then stir vigorously with a glass rod. If the ordinary procedures, such as, using a mortar and pestle, is employed with these substances gummy lumps are formed which are exceedingly difficult to dissolve.

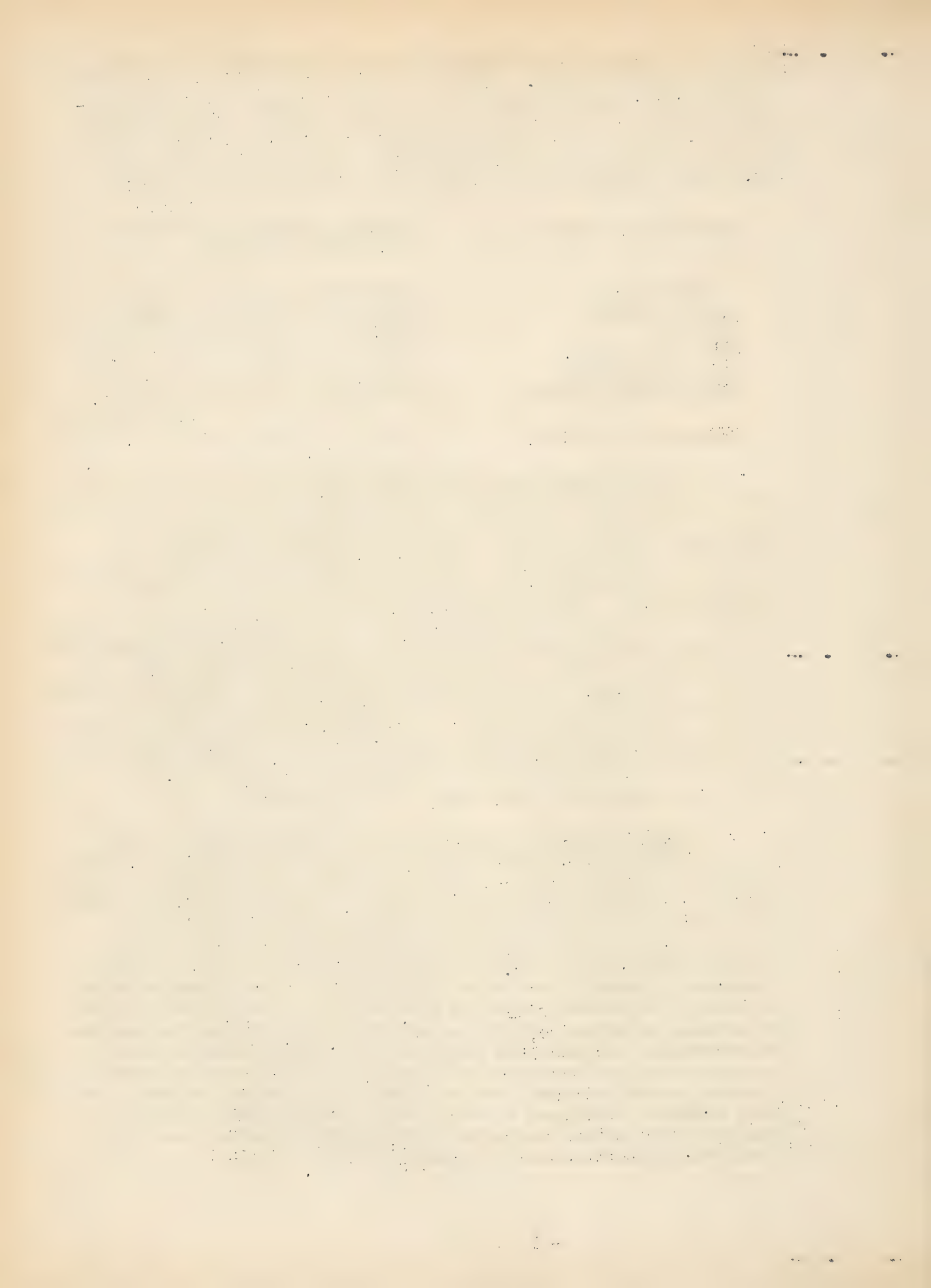
(1) The solubility of chemicals and the miscibility of liquids are important physical factors which the pharmacist should

know as they often have a bearing upon the intelligent and proper filling of prescriptions. Mainly for the information of the pharmacist the U.S.P. gives figures to indicate the degree of solubility or miscibility of the various official substances. When in Pharmacopoeial texts it has not been possible, or in some instances not desirable to indicate exact solubility, a descriptive term has been used. The following table indicates the meaning of such terms:

<u>Descriptive terms.</u>	<u>Relative quantity of solvent for 1 part of solute.</u>
Very soluble.	Less than 1 part of solvent.
Freely soluble.	From 1 to 10 parts of solvent.
Soluble.	From 10 to 30 parts of solvent.
Sparingly Soluble.	From 30 to 100 parts of solvent.
Slightly soluble.	From 1 to 1,000 parts of solvent.
Very slightly soluble.	From 1,000 to 10,000 parts of solvent.
Practically insoluble.	More than 10,000 parts of solvent.

k. The Effect of Solution on Temperature. - In making a solution, the temperature may rise or fall. When chemical reaction takes place it will almost invariably rise. In making a solution of ferrous iodide from iron, iodine and water, sufficient heat may be generated to boil the water. Or, in dissolving a salt from which the water of crystallization has been driven off, as in anhydrous sodium carbonate, the temperature will rise on account of the salt combining with water of crystallization. Even dissolving some salts which do not occur normally with water of crystallization as potassium acetate, may cause rise of temperature; perhaps in solution it is combined with water. In dissolving a very quickly soluble crystalline salt in water, the temperature falls noticeably, as on dissolving potassium iodide in water, due to the change of active heat to latent heat, the heat being taken up to keep the solid in liquid form. A mixture of ice and salt is used as a freezing mixture, because as both solids change to liquid, much heat is taken up.

l. Stock Solutions - Some chemicals dissolve slowly in water. In the pharmacy where frequent demands are made for such chemicals, much time and trouble can be saved by keeping these in concentrated solutions. Or, some chemicals have such an attraction for water that they become wet while weighing and consequently are difficult to weigh accurately. Stock solutions are generally made up so that a certain number of cc. or one cc. contains a certain number of grams of chemical. Some of the salts most commonly kept in stock solution are mercuric chloride, potassium chlorate, potassium acetate, potassium iodide, potassium bromide, ammonium chloride, magnesium sulfate, and strychnine sulphate; the list varies in different pharmacies, depending upon the frequency of the call for them. Some of these solutions do not keep well and may have to be made up frequently in small amounts. Sometimes a preservative can be added, as sodium chloride to mercuric chloride solution to prevent reduction to mercurous chloride, or alcohol to alkaloidal solutions.



m. Volume. The volume of a solution is less than the sum of the volumes of the ingredients, but greater than the volume of the solvent. Seventy-five grams of sugar increase the volume of the liquid about 50 cubic centimeters; 40 grams of potassium iodide, about 12 cubic centimeters; 10 grams of camphor in alcohol, about 10 cubic centimeters. The amount that a solid will increase the volume when it goes into solution varies with the solid and cannot be determined except by experiment. In filling prescriptions it is customary to add enough of the liquid to bring it up to a given volume. A solid dissolved in water generally increases the specific gravity, raises the boiling point, and lowers the freezing point. Two liquids on being mixed sometimes contract, as alcohol and water. In making diluted alcohol the contraction is made up by adding water to get a volume which is the sum of the two.

n. Solution of Gases in Liquid. The solubility of gases in liquid decreases proportionally with increase in temperature. The solubility of gases in liquids increases proportionally with increase in pressure.

o. If a substance absorbs moisture from the air it is said to be hygroscopic, as powdered opium. If it absorbs enough to liquefy it is said to be deliquescent as potassium acetate. If a substance is free from water, particularly from water of crystallization, it is said to be anhydrous, as dried alum. If it gives up its water of crystallization on exposure to air, it is said to be efflorescent.

9. Separation of Solids from Liquids. Various methods for the separation of solids from liquids are in use, depending upon the volume of the mixture and upon the result wanted. Sometimes the solid matter is wanted, sometimes the liquid, and sometimes both. In the army pharmacy the processes will be limited to straining, filtering, decanting, or clarification.

a. Decantation. In some cases it is more expedient to wash a precipitate by placing it in an appropriate glass vessel, such as a beaker or a flask, mixing thoroughly with the wash liquid, and allowing it to stand until the precipitate has completely subsided and then removing the liquid by decantation; this is especially true of flocculent and bulky precipitates such as ferric hydroxide, aluminum hydroxide, or magnesium hydroxide. That is, by gently lifting the container and gradually tilting same until the major part of the liquid has been removed from the precipitate. It is manifestly impossible by this means to thoroughly remove all the liquid, as no matter how carefully decantation is continued, certain portion of the precipitate will be disturbed and flow out with the decanted liquid, which therefore, should be passed through a filter to collect the escaping precipitate. Repeated decantation however, will enable us to remove most of the soluble matter from the precipitate. Thus, a precipitate contains 100 grams of soluble impurities: by treating with 1,000 cubic centimeters water, the 100 grams soluble matter will dissolve. By decanting this, it is possible to remove 900 cc. of the liquid without seriously disturbing

the precipitate, and in 900 cc. 90 grams of soluble impurities will be contained. To the remaining liquid and the precipitate another 1,000 cc. of water is added, the product thoroughly mixed, and the precipitate allowed to settle. When 900 cc. of this second liquid are removed it means that of the 10 grams of soluble substance remaining, 9 grams will have been removed leaving with the precipitate but 1 gram of the original 100. The operation repeated, the 900 cc. of the decanted liquid will remove 0.9 of the remaining gram of the soluble impurities, and thus, after three such washings, about 1-1000th of the original impurities remain. Ordinarily, however, such thorough washing by decantation is not carried on as it means the use of too much water.



DECANTATION
FROM A BEAKER



DECANTATION FROM
A PRECIPITATING JAR

(1) Apparatus - Apparatus for decantation is the container mentioned above, consisting either of a pint flask or a beaker, provided with a pour-out lip. To facilitate the removal of the decanted liquid a glass guiding rod is used. The method of application is best shown by appended figures. To avoid the possibility of any liquid being drawn over to the outside of the beaker by the capillarity of the glass the edge of the beaker should be smeared with traces of some fat. If the container is full or if the precipitate stirs up easily, it may be better to siphon off the liquid.

b. Colation or Straining is the separation of a solid from a liquid by passing through a coarse filtering medium as a sieve, a piece of cheese cloth, muslin, domestic, linen, flannel, canton flannel, felt, chamois, or moleskin. These agents are used only when coarse particles are to be removed or where the liquid is too thick to pass through a filter paper. In practically every case the strainer should first be wet with the liquid the same as that in the mixture to be filtered. Cheese-cloth, muslin, domestic, and linen are used only to take out the coarsest particles. Canton flannel, flannel and felt will take out finer particles and may be used with thick liquids. Chamois and moleskin are used chiefly in

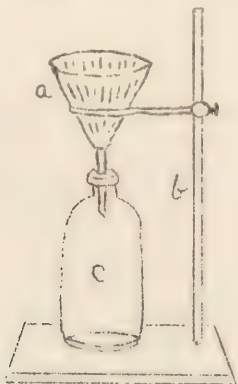
straining oils. The strainer may be held by tenaculum which is a frame with projecting brads or nails on which the cloth is hung. With thick liquid suction or pressure may be necessary.

c. Filtration. Filtration is a nearly perfect variety of straining; in both processes the operation of clearing the liquid being purely mechanical. The substance which removes the impurities is called the filtering medium, and the clear liquid, the filtrate.

(1) Apparatus used in filtration consists of the bottle or other container into which the filtrate drops and the container holding the filtrate medium. The latter in small operations consists usually of a funnel.

(a) Funnels consist of conic vessels of glass, porcelain, or metal, although the latter should be carefully avoided in delicate pharmaceutic operations. To secure the best success from the funnel it is necessary that the cone shall be at an equilateral triangle, as otherwise folded filter paper will not accurately fit same. Of the many varieties of funnels suggested for the pharmacy technician's use, a very popular form of funnel is the one with the ribbed interior to permit the passing down of the filtered liquid. This, however, can be accomplished with a plain funnel just as well by the plaits of a carefully folded filter.

Some funnels are provided with a groove on the under side of the neck of the funnel to permit the exit of air from the bottle into which the liquid is filtered. It is better pharmacy, however, not to place the funnel directly in the neck of the receiving bottle, but to support it on a ring of the retort stand. If circumstances are such that the funnel must be placed in the neck of the bottle, some provision for access of air must be made, and this is done by interposing between the neck of the funnel and that of the receiving bottle a piece of cord; otherwise the air within the bottle becomes compressed as the liquid passes into the bottle until either the liquid ceases to filter through or the air, in forcing its way out, pushes with it a certain quantity of the filtered liquid to the outside of the receiving flask, producing an untidy operation.

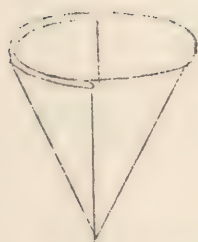
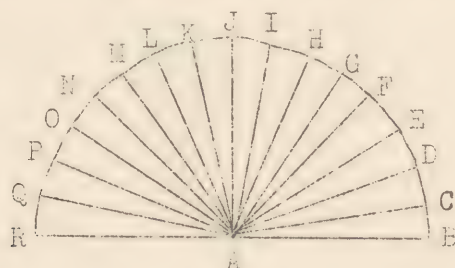


CORRECT FILTRATION

a. Funnel; b. Filtering Stand
c. Receiving Bottle.

(b) Filter paper, cotton, asbestos, sand, charcoal, talc, paper pulp, magnesium carbonate, calcium phosphate, glass wool, and unglazed porcelain, are used as filtering mediums. Filter paper, which is unsized paper, is the most convenient, and can be obtained in varying degrees of thickness and porosity, suitable for different purposes. Only the white paper should be used, as the gray is impure and may give coloring or solid matter to the filtrate. Hardened filter paper is paper which has been treated with nitric acid which makes the paper much stronger, makes the pores finer, and makes the surface smoother so that precipitates can be more easily removed without getting fibers of the paper; it is generally necessary to use pressure or suction with it.

A plain filter is one which has been folded twice so that when it is open it will make a cone and will lie flat against the side of the funnel, having three thicknesses of paper on one side and one thickness on the other. If the precipitate is to be washed, only a plain filter should be used. A plaited filter is folded to make usually sixteen or thirty-two sectors or faces; the filter rests on the edges of the fold, forming channels between the paper and funnel, down which the filtered liquid may run. On account of these channels the liquid will pass through more rapidly.



PLAIN FILTER



PLAITED FILTER

To fold a plaited filter, (see figure) fold the circle of paper as for a plain filter. Open it up so that it is folded once, making a semicircle RJB with a crease at AJ. During the folding the paper should not be taken entirely off the table. The crease should not be made clear to the apex A, otherwise the paper at the apex becomes weakened. Pick up the corner B and lay the edge AB on the crease AJ, pressing down on the paper to make the crease AF. Pick up the edge AB and lay it on the crease AF, pressing down on the paper to make the crease AD. This will make the sector ABD. Now fold back one half of this sector on itself, making the edge AB to lie on the edge AD and press down on the paper, making the crease AC, thus dividing the sector ABD into equal sectors, ABC and ACD. Then with the edge AB lying on the edge AD,

carry both edges over so as to close the crease AF and then fold back on itself so that the edges AB and AD will lie on the edge AF, pressing down to make the crease AE. Carry the three edges AB, AD and AF over so that they will lie on crease AJ, pressing down to make the crease AH. Then fold back, making the edges AB, AD and AF to lie on the edge AH, pressing down to make the crease AG. Carry these four edges over so as to close the crease AJ and fold back to make these four edges lie on the edge AH, pressing down to make the crease AI. The other semi-circle is folded similarly. This makes thirty-two sectors. On opening it will be seen that two sectors will lie flat against the funnel, each can be creased to make two more sectors..

(2) The observance of the following details will contribute to attaining the ideal in filtration:

(a) The folds of the filter should not be permitted to extend to the point of the filter, but in plaiting the filter the crease should be made from the point toward the edge, a finger being kept on the point to prevent the creasing of same. The necessity of sparing the point can be understood when it is appreciated that every crease in the piece of paper contributes to the weakening of same, and, therefore, the passing of sixteen creases across the central point forming the tip of the filter is apt to so weaken it that it will break as soon as the liquid is poured upon it, the greatest pressure of the liquid being exerted on the filter tip.

(b) The filter should be moistened before filtering. This opens the pores of the filter, rendering easier the passage of the liquid through the filter. It is needless to say that the filter should be moistened with the liquid which is the solvent for the drug intended to be filtered. Thus, to moisten with water a filter through which it is intended to pass, essence of ginger, would be doing much more harm than good. The moistening of such a filter should be done with alcohol.

(c) When the filter is moistened, it is advisable to push the tip of the filter fairly well down in to the neck of the funnel. This serves to strengthen the filter tip.

(d) In pouring the liquid on the filter, avoid throwing it directly on the tip, but gradually pour it upon one side of the filter, as otherwise the force of the fall is apt to rupture the paper.

(e) The paper should not project above the funnel. It is a human failing to fill the filter as completely as possible, and in case the paper projects over the side of the funnel, the actual level of the liquid may be above the top of the funnel, and a rupture of the paper brings disastrous results. The chief reason, however, for this rule is that the projecting paper affords considerable surface exposed to the air, thereby producing spontaneous evaporation with the accompanying lack of the liquid. This is particularly the case when the liquid to be filtered is volatile.

(3) Cotton Filter. - In many cases of simple filtration all that is necessary to remove insoluble matter is the passing of the liquid through a pledget of cotton placed in the neck of the funnel. This method of filtration is one which should be practiced more frequently in the army pharmacy than is usually the case. Every prescription calling for a solution should be dispensed absolutely clear, and to insure this, a finished solution should be filtered through cotton before dispensing.

(4) Filtration through absorbent powder. - This is a modification of filtration where the separation of the insoluble matter is facilitated by the use of some powder that has the property of adsorbing such material. On a small scale the powders employed are magnesium carbonate, talc, infusorial earth, etc., these being used to aid filtration through paper. In this way some of the official aromatic waters are prepared, talc usually being employed.

(5) Asbestos Filter. - Instead of a plug of cotton a similar plug of purified wooly asbestos inserted in the neck of the funnel affords an admirable method for the filtering of strong acid or alkaline liquid, which would destroy filtered paper or cotton.

CLARIFICATION, DECOLORIZATION, and SEPARATION of IMMISCIBLE LIQUIDS.

10. Clarification is the process of clearing a liquid without the aid of filtration. As filtration is a simple and thorough operation, clarification is substituted for it only in cases where filtration is difficult, if not impossible, as in the case of mucilaginous and other viscid liquids which will not pass through the pores of a filter, or where the quantity of fluid is too great for ordinary filtration. The clarification of liquids, wherever possible, is accomplished by means which are purely mechanical; clarification by means of chemicals not being recommended because of danger of alteration of the liquid during the process. The apparatus for clarification is usually of the simplest character, consisting generally of vat, kettle, or dish, and some form of strainer through which the liquids are passed to remove it from the solid. Clarification is accomplished in the following ways:

(a) Heating - In many cases the liquid to be clarified is turbid by reason of suspended or partially dissolved albumin or wax. In such cases heating usually accomplishes clarification by coagulating the albumin, or by causing the waxy substance to liquefy and rise to the surface. After such cases of clarification the cooled liquid is either strained, or the separated solids float on the surface scum and are removed by skimming.

(b) Increasing Fluidity. - In some cases the particles of dirt, grit, and straw, make turbid a fluid which is so viscid that these particles can neither rise to the surface of a liquid, if lighter than same, nor sink to the bottom if heavier. This can be remedied by diluting the liquid with water until sufficiently limpid to permit separation of the solid matter and then

evaporating the excess of water.

(c) By Use of Albumin. - The method given above is not always satisfactory, as frequently it is inconvenient to evaporate the excess water, and, moreover, it is often the case that the particles do not separate of their own volition. The separation of these particles can be facilitated by thoroughly mixing white of egg with the liquid and then heating the mixture, when the albumin coagulates and rises to the surface of the liquid, carrying with it the mechanical impurities, which are skimmed off along with the solidified albumin. By this process boiled coffee is rendered clear.

(d) By Use of Milk. - In the above operation milk is sometimes substituted for albumin, this acting the same way by reason of the coagulation of the casein it contains.

(e) Paper Pulp. - A similar mechanical separation of the particles can be accomplished by tearing filter paper into shreds, and mixing it thoroughly with the liquid, and heating. When the paper rises to the surface it carries with it the suspended particles, which are removed by skimming.

(f) By Sedimentation. - If the particles rendering the liquid turbid are sufficiently heavy, they will settle to the bottom of the containing vessel, even though the liquid is quite viscid, if sufficient time is given to accomplish separation. This slow method of separation is called sedimentation, and the insoluble matter finally settling at the bottom of the vessel is called the sediment. The term precipitate, frequently applied to the sediment is incorrect, as by precipitate we mean insoluble matter which has been in solution, whereas the particles composing sediment have never been dissolved.

(g) By Use of Gelatin. - Gelatin is employed for clarifying liquids containing tannin, the action in this case being chemical, and not mechanical. Gelatin forms with tannin, an insoluble combination, similar to leather.

(h) By Fermentation. - This method of clarification is not usually used in the army pharmacy, and it is suffice to state that this is limited to the preparation of fruit juices.

11. Decolorization. - Decolorization is the process of removing color from a substance and is usually accomplished by macerating the solution with animal or vegetable charcoal for several days and then filtering. Freshly precipitated aluminum hydroxide silica and some silicates, many other substances which when freshly precipitated, produce voluminous or gelatinous precipitates, have the property of removing, to some extent, solids in solution. This is generally done by adsorption. Because of this property, they are used to decolorize solutions of sugar, alkaloids, glucosides, oils, and many other compounds. They frequently take out some of the active principles as well as the coloring matter, holding them

quite firmly. Charcoal is used more than any of the other decolorizing agents. Animal charcoal made from bone or blood has been preferred to wood, because of its greater power of adsorption but some other forms of carbon now made, as from peat or seaweed, are more effective than animal charcoal. If the solution to be decolorized is acid, the decolorizing agent must be one which is insoluble in acid; the silicates and charcoal must be first purified by treating with acid, preferably hydrochloric, because any excess and any chlorides are easily washed out. Because of the power to remove alkaloids from solution, charcoal has been given as an antidote in some cases of poisoning by alkaloids. When charcoal has been used in decolorizing and alkaloidal solution, part of the alkaloid can be recovered from the charcoal by extracting with strong alcohol.

12. Separation of Immiscible Liquids.--By immiscible liquids we mean two liquids which do not dissolve in each other, for example, water and oil, and in cases where these two are brought together, it is very frequently useful to have a means of separating them readily. Immiscible liquids are separated by several methods.

a. In case the amount of one of the liquids is very small, it can be separated from the other by means of a pipette, one end being placed in the liquid, which is drawn into the pipette by means of suction. If the lower layer is to be taken out, the fingers should be held tightly over the upper opening of the pipette, while the lower is passing through the upper liquid.

b. Immiscible liquids can be separated by a separatory funnel which consists of a bulb terminating in a stem with a stop-cock. The mixture is poured into the funnel and when the heavier liquid has settled it is drawn off. In extracting a water solution from ether, chloroform or other immiscible liquids, an emulsion is sometimes made which is hard to break. Standing, gentle twirling, addition of alcohol, or the use of the centrifuge may break it, but it is better to avoid the formation if possible.

PRECIPITATION, CRYSTALLIZATION, GRANULATION, EXSICCATION

13. Precipitation is the process of separating a solid from its solution by the aid of physical or chemical action. The substance so separated is called a precipitate; the chemical producing this precipitate is called the precipitant, while the liquid remaining above the precipitate substance is termed the supernatant liquid.

As mentioned previously, a precipitate differs from a sediment in that a precipitate is separated out from its former state of solution, while a sediment has never been dissolved. In order to precipitate a substance it is necessary to first get it into solution. On the other hand, the precipitated substance is, in the nature of things, a substance insoluble in water, and must, therefore, be dissolved by special agents, the acts of solution frequently bringing about a chemical change.

Precipitation may be due to chemical or physical causes. The most important phase of precipitation is that involving chemical

action, wherein the two reacting substances are dissolved in separate portions of water, and on mixing the solution, an insoluble body will be formed and precipitated.

But we have precipitations that are due to purely physical causes. Thus, from a hot super-saturated solution on cooling will be precipitated the excess of dissolved substance. Likewise, solution of such substances which are more soluble in cold water than in hot, (like lime) will be precipitated when they are heated, such cases being examples of precipitation through change in temperature. We have learned that substances may be soluble in one liquid and insoluble in another; thus gum arabic dissolves in water to form a colloidal solution but is insoluble in alcohol. If alcohol is added to a solution of acacia, it diffuses through the water and the acacia is precipitated, an example of precipitation through change in menstruum.

a. The Objects of Precipitation. (1) We precipitate substances chiefly to purify same. As will be noted later, the purification of chemicals which are soluble is easily effected by crystallization, and likewise, the purification of insoluble chemicals is generally accomplished by precipitation, and in both cases the act of purification is accomplished by first bringing the substance into solution. Therefore, in precipitation we dissolve a substance in some way usually by changing the identity of the chemical. The solution thus obtained is rendered free from insoluble extraneous matter by filtration, and to the filtered liquid is added the appropriate precipitant, which converts the chemical into the insoluble form desired, leaving the soluble impurities in the supernatant liquid.

(2) Another object of precipitation is to obtain the substance in fine powder, the insoluble matter usually separating out in an extremely fine state of subdivision.

(3) A third object of precipitation is for its value in chemical testing. Practically the entire scheme of analytic chemistry is based on the separation of compound of the various elements from solution by the addition of an appropriate precipitant.

b. Operation. (1) As mentioned above, precipitation can be accomplished by either physical or chemical means, although by far the greater number of precipitates used in pharmacy and chemistry are produced by chemical means. Among physical means of precipitation is the use of heat, as shown by the precipitations of the egg albumen from the mixture by heating when the albumen coagulates, as explained previously.

(2) Another physical form of precipitation is by changing the nature of the solvent. As mentioned previously a substance may freely dissolve in one solvent, but be insoluble in another, and in such cases the addition to the solution of the substance of the liquid in which it is insoluble usually effects the precipitation of the solid, provided always that the added liquid is freely mis-

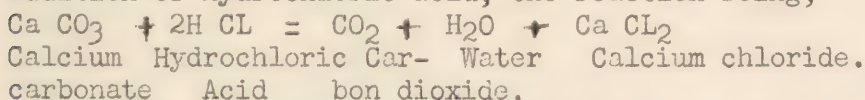
cible with the liquid which holds the salt in solution. A case of this kind is that of acacia, which will be precipitated from its aqueous solution on the addition of alcohol. This separation, it will be noted, is purely physical, and it differs from the precipitation of acacia from its aqueous solution by the addition of lead subacetate, in which case chemical change is effected.

(3) Among the chemical means of precipitation it is possible to include the action of light. Even that precipitation is frequently considered as a physical means, but it is true that precipitation affected by light is brought about by the light changing the chemical character of the precipitated substance. Some cases where light produces precipitation is with the salts of filter. Almost every pharmacist has noted the precipitation occurring in solution of silver nitrate exposed to the light when the sides of the vessel becomes coated with a black substance, which is metallic silver, the light acting on silver nitrate reducing it to the metallic form. The usual chemical method of precipitation, however, is by adding a precipitant, as mentioned above, and as illustrated in the manufacture of precipitated calcium carbonate from prepared chalk.

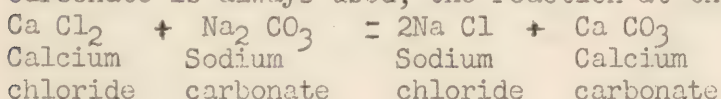
These two substances are chemically identical, the only difference being that prepared chalk - a natural product - is only slightly purified by the process of elutriation and trochiscation; hence is apt to contain more or less impurities, and it is freed from these impurities by the process of precipitation.

In converting the prepared chalk into calcium carbonate, five stages in the operation may be noted. The first is to get prepared chalk or the calcium part of it into solution, for it is through solution that a substance can be readily freed from impurities.

To affect this solution a chemical change is necessary; in other words, the insoluble calcium carbonate must be converted into a soluble salt of calcium and the salt selected is calcium chloride. This calcium chloride is produced from the prepared chalk by the addition of hydrochloric acid, the reaction being;



The calcium chloride solution so obtained is filtered to affect a separation of insoluble particles, and this filtration might be considered the second stage of the process. The third stage of the process is the real precipitation, which is accomplished by adding to the solution of calcium chloride the precipitant, which is a solution of any soluble carbonate, and for practical purposes sodium carbonate is always used, the reaction at this stage being:



It will be seen that, besides calcium carbonate (precipitated chalk), sodium chloride is formed, and the moist precipitated car-

bonate is wet - not with pure water, but with a solution of salt. If we dry the precipitate just as it separates from a liquid of which it once was a part, we get a product contaminated with salt, but if we wash it, the sodium chloride dissolves, leaving behind pure calcium carbonate moistened only with water.

Therefore, we wash the moist precipitate, this constituting the fourth stage in the process of precipitation. Lastly, the moist precipitate must be dried, which constitutes the fifth and last stage of the process.

c. Apparatus--Apparatus used in precipitation by chemical means consists of a chemical flask or evaporating dish in which the insoluble substance is made into the soluble form, the funnel and filter by means of which the solution is rendered clear, the jar or dish in which the filtered solution is mixed with the precipitant, and where the precipitate is allowed to collect, a strainer or a plain filter in which the precipitate is collected and washed, and lastly, a drying closet or other means of desiccation by which the moist precipitate is dried. All these pieces of apparatus have been considered except the precipitation jars; these consist either of tall cylinders or of beakers, both of which were illustrated under Decantation. The precipitating jar is of glass, made tall in order to effect the complete separation of the precipitate, thus facilitating decantation; the beaker is a vessel of thin glass so annealed as to stand heating.

For precipitation in chemical testing, test tubes are usually employed. These consist of narrow cylinders of glass, five or six inches long, with round bottom, while in quantitative analysis the precipitates are carefully collected in a beaker.

(1) The appearance of the freshly separated precipitate is described by appropriate adjectives, most of which are self explanatory. Thus, we say that silver chloride is curdy; ammonio-magnesium phosphate is crystalline; aluminum hydroxide is gelatinous; coagulated albumin is flocculent, and magnesium phosphate is granular. Sometimes, when a precipitate is light and occupies considerable space, it is said to be bulky. A magma is a form of thick, tenacious precipitate, such as is formed by magnesium hydroxide in the official magma of magnesia.

(2) In some cases the same substance can be precipitated in a light, flocculent form or in a heavy, granular form, giving rise to the distinction between light and heavy precipitates. These result entirely from the method of manipulation. If, in precipitating the substance, the solutions are dilute and cold, a light precipitate is usually formed, whereas if the two substances are mixed in hot concentrated solution, a heavy precipitate is formed. An official illustration of these two forms of the same substance is shown in magnesium oxide, U. S. P., and heavy magnesium oxide, these being produced by the calcination of light magnesium carbonate and of heavy magnesium carbonate, respectively, the light being precipitated from dilute solution and the heavy from concentrated solution.

14. Crystallization. Crystallization is the process of separating substances in forms possessing definite geometric angles. Such substances are called "crystalline" while substances which cannot be made to form definite geometric angles are said to be "amorphous," which some physical chemists consider as undercooled liquids. Or, we may say, an amorphous substance is one in which the atoms or molecules are distributed in a random manner. On the other hand, a crystalline substance has definite geometrical internal arrangement as the atoms and molecules. A common analogy is that an amorphous substance resembles the disordered arrangement of people found in a crowd, while a crystalline substance resembles the regularity seen in an organized body of soldiers in formation in which each soldier takes a definite position according to certain regulations (laws of crystallization).

a. The object of the pharmacy technician in producing substances in crystalline form is to obtain them in a higher degree of purity.

b. The several ways in which crystals are produced are as follows:

(1) Cooling a hot saturated solution. This is the usual method of producing crystals in chemical manufacture, and the process can be readily understood by one who has studied the preceding work on Solution. Therein it was noted that a substance is usually more soluble in hot water than in cold; furthermore, that from this hot solution, on standing, will be deposited the excess of the substance. Thus, 100 cc. of boiling water will dissolve nine times as much potassium chlorate as will 100 cc. of water at 25° centigrade, and when the temperature of this heated solution is reduced to 25° centigrade the 80 per cent excess will separate out and in the form of crystals, hence the body is crystallizable. Such is the usual method of making crystals, the substance being dissolved in hot water, the hot saturated solution filtered through paper, the filtrate allowed to stand in an appropriate dish, usually for twenty-four hours, when the liquid is separated from the crystals which are then removed from the dish and dried.

(2) By the gradual evaporation of a solution. This consists of a modification of the foregoing, the crystallizing solvent being in this case alcohol, ether, chloroform, or some other volatile liquid. In such cases the chemical (usually of plant origin) is dissolved in the smallest possible quantity of the liquid, the solution filtered into an evaporating dish and allowed to stand, when, due to the gradual vaporization of the solvent, the crystals slowly form in the bottom of the dish. In such cases the crystals should be removed before the solvent has completely dissipated, in order that the impurities may be removed in the residual solvent.

(3) Sublimation. Some chemicals on subliming, solidify in the form of crystals. For example, iodine, mercuric chloride, benzoic acid, salicylic acid and many other organic compounds. The process of sublimation has been explained previously.

(4) By fusion and partial cooling. This method of crystallizing is of little value to the pharmacy technician, its only application being in the preparation of one form of sulphur crystals: Therefore, it is suffice to state that, on heating some metals, such as tin, to a point short of fusion, they assume a crystalline structure. Some solids when fused, assume the crystalline structure on cooling, as sulphur.

(5) By affecting change in the character in the solvent. As mentioned under the discussion of solution, some substances are soluble in one solvent and insoluble in another. For example, sugar will dissolve freely in water and sparingly in alcohol. In this case, if to the concentrated solution of sugar is added alcohol in sufficient quantity, the sugar will separate out, and in the form of crystals. This method is used in effecting crystallization in many chemical operations, although its use in pharmacy is comparatively limited.

(6) By the electric current. This method is commonly known as electro plating and the deposited metal consists of extremely small crystals.

c. Water of crystallization. In the case of crystallization produced by a separation from a solution, the solvent very frequently plays a role in the composition of the deposited crystal, although in some cases the crystal separates from the solution without combining with any of the solvent. The latter is usually the case when some solvent other than water is employed but sometimes, in separating from aqueous solution some chemicals form crystals that are water free. If water combines with the separating crystals, as is usually the case in aqueous crystallization, it is designated as "water of crystallization", and if alcohol combines with the chemical in the same way, it is called "alcohol of crystallization". The same substance does not always contain the same number of molecules of water of crystallization. Sodium carbonate, for instance, usually contains ten molecules. Under some conditions it may be made to crystallize with eight or with only five molecules, and in the official form it contains but one molecule of water.

d. Interstitial Water. Among the chemicals which separate in crystal form from aqueous solution, without the absorption of water of crystallization, the best known example is common salt. This separates in handsome masses of cubical crystals, and, in separating, this very frequently mechanically incloses certain quantities of water which must be clearly differentiated from water of crystallization, because it is retained in a purely mechanical manner. Such water, which gathers in the interstices found in a mass of crystals, is called "interstitial water." On heating a substance containing interstitial water the latter is converted into steam, which on expanding, tears the crystal mass asunder with a crackling sound. This phenomenon called decrepitation, is different from the deflatration of potassium nitrate, which is due to the liberation of oxygen.

e. Efflorescence is the process whereby crystals containing water of crystallization usually lose part or all of its water upon exposure to the atmosphere, resulting in crumbling and loss of original crystalline form.

f. Hygroscopic substances slowly absorb moisture from the atmosphere.

g. Deliquescent substances take up moisture rapidly from the atmosphere and in sufficient quantities to cause them to liquefy.

15. Granulation is best defined as interrupted crystallization, while the operation of granulation is the process of heating a chemical substance with constant stirring until moisture is evaporated and sabulous (coarse-grained) powder is produced. Since the pharmacy technician will not be called upon to perform granulation it is sufficient to say, that chemicals in granular form have become more popular due to the more rapid solubility of same than the larger crystals, following the statement made under the discussion of Solution, that the latter is facilitated by comminution of the dissolving substance.

16. Exsiccation is the process of removing water of crystallization from a chemical by the use of strong heat. This process has been explained previously, so here it need only be added that the chief object of exsiccating a substance is to reduce its bulk. Thus, a crystal of alum weighing ten grams contains but little less than five grams of water, and but little over five grams of the chemical itself, hence five grams of exsiccated alum represents the same strength as about ten grams of the crystal.

EXTRACTION

17. Extraction. Under the head of Extraction are grouped the processes in which the active and soluble constituents of a drug are separated from the insoluble portion by the use of appropriate solvent. These processes comprise maceration, expression, percolation, digestion, infusion, and decoction.

In order to understand the principles underlying the process of extraction it is necessary to appreciate the structure of the ordinary vegetable drug. Any drug representing a plant part is comprised of a collection of cells, lately living or long dead, each one of which possesses a wall of more or less thickness, this wall consisting of some variety of cellulose, (possibly infiltrated with lignin) or tuberculous, corky tissue. The cell wall is an insoluble, thick envelope, scarcely permeable to liquid, while the active principles which we seek are generally found in the orifice encircled by the wall. To get the solvent in direct contact with the soluble constituent within the cell it is necessary that the cell-walls be ruptured, hence in extraction we must first comminute the drug. The cells in some drugs are larger than others, hence some drugs are directed to be powdered more finely than others in various pharmaceutical processes, the aim of the pharmacopoeia being to reduce the powder to a fineness sufficient to insure the breaking of every individual cell.

The quantity of the cell wall, as compared to the amount of constituent is usually many times greater. Thus, for example, in cinchona bark we find that but five per cent of the total amount is alkaloids, and no more than thirty per cent of the whole is soluble matter. Therefore, the primitive method of administering the crude drug in powdered form meant the consumption, by the patient, of a large amount of not merely inert but indigestible woody tissue, in order to get a small amount of medicament. To obviate the necessity of administering this large quantity of inert matter is the prime objective of extraction, and in each case cited above it is accomplished by treating the drug with an appropriate solvent, and the removal, by solution, of the useful principles from the inert, insoluble residue.

18. Maceration. a. Maceration is the process of removing the active principles from a drug by allowing the latter to remain at room temperature in contact with the solvent several days, with frequent agitation.

b. Roughly stated, maceration consists of reducing the drug to appropriate fineness of powder, placing same in a suitable bottle, pouring on the solvent, which is called menstruum in all cases of extraction, and letting the mixture stand for a week, shaking at frequent intervals. The solution is then removed from the inert matter by filtration or straining, and the yield of the filtrate increased by subjecting the residue to expression.

c. Some claim that the process of maceration in the preparation of tincture has the following advantage over the process of percolation; first, that the drug need not be powdered as finely as in the case of percolation, second, that the process requires less skill, less percolation, and hence requires less care in the manipulation, and third, that in the process of maceration there is less loss of alcoholic menstruum than in the making of the same preparation by percolation. The latter is practically the only advantage possessed by maceration over percolation, the other questions not being worthy of attention of the intelligent and well trained pharmacy technician.

d. In large quantities of a preparation made by maceration, the shaking of the bottle containing the drug and menstruum is a laborious task, and since the shaking is merely to bring all portions of the solvent in contact with the drug, and as the same result can be obtained by the process of circulatory solution, as has been explained before, this method can be employed in the maceration of tincture, the ground drug being placed in a cloth bag and suspended directly below the surface of the solvent.

e. As mentioned above, the inert residue remaining after maceration (which is called the marc) is impregnated with the tincture itself and in filtering off a macerated tincture the residue on the filter is not wet with alcohol, but with full strength tincture. Hence, it can be seen that the process, at its best, is wasteful; that the drug is never completely exhausted of its active principles, and the less care used, the more waste there is to the process. The waste is partially obviated by "squeezing the dregs", as we commonly say; by expressing the residue.

19. Expression. This is a process of removing the liquids from the moist mass by the use of pressure, one of the best pharmaceutical illustrations of the application of expression being in the removal of the remaining tincture from the marc.

a. Many forms of pressures have been devised, each adapted for some special phase of expression. In the army pharmacy the process of expression will be limited to the straining of the expressed liquid through suitable cloth. We therefore, usually enclose the mass to be expressed in a bag of stout cloth (press cloth) before expressing it. Such press cloth (strong toweling will do) can be used directly for expressions which process means removing the straining cloth from the frame, gathering between the hands by twisting movement the strainer and the residue thereon, and then expressing.

20. Digestion.--Digestion in the ordinary pharmaceutic sense is maceration with warm water; that is, water heated below its boiling point. This is usually accomplished by placing the vessel containing the drug in the water in a warm place, such as the back of a stove or on a radiator. In certain cases of digestion however, as in certain chemical practices, the material is digested with water or with some other solvent at high temperatures in an autoclave.

21. Infusions.--Infusions are preparations made by the maceration or percolation of vegetable substances with water. In some of the official infusion the water used as the extracting solvent is applied cold, but usually it is poured on while boiling hot. It is used cold for such drugs as wild cherry, the active principal of which, hydrocyanic acid, would be driven off or its formation would be prevented by the temperature of boiling water.

a. They quickly spoil, and should be freshly prepared whenever called for. It may be said that in making infusions by hot maceration the coarsely ground drug is put into a suitable vessel, boiling water is poured upon it, and the maceration permitted to continue a half hour or an hour. In preparing infusion any suitable glass or porcelain vessel--say, a teapot or a beaker--can be used. It is convenient to prepare the infusion by circulatory solution, that is, the ground drug is placed in a small piece of straining cloth and suspended just below the surface of the boiling water. The general formula directs that 5 grams of drug be used in making 100 cc. of infusion. Infusions should not be made by diluting fluid extracts, as alcohol may dissolve out quite different principles than what water does. Infusions should be strained but not filtered, consequently they are frequently not clear.

22. Decoctions.--These are liquids made by boiling the drug for 15 minutes or longer with water. Putting on cold water first, extracts some of the principals which might not have been taken out by hot water. Drugs suitable for decoction frequently contain albuminous matter, which, if coagulated by putting boiling water on at first, would hinder the solution of the active matter. Decoctions are free from albumin but may contain much starch. Hard parts of plants such as roots, barks, and woods are suitable for making decoctions and they

should not be ground to a fine powder. On account of the great amount of heat necessary, drugs containing volatile oils and easily decomposed principles are not suitable for making decoctions. The general formula directs that 5 grams of drug be used in making 100 cc. of decoction. Decoctions spoil very quickly, but if proper precautions are taken they will keep longer than infusions because the boiling sterilizes the preparation. They are more turbid than infusions and frequently have a much heavier precipitate, because they are strained at 40° centigrade. This temperature is directed, because some active matter may still be in solution, but precipitated at room temperature and would be removed if strained at room temperature. The U.S.P. gives only a general formula.

23. PERCOLATION.--a. Definition--Percolation is the process of depriving a drug of its soluble constituents by passage of a solvent through the powder contained in a suitable vessel. The solvent in this case is called the menstruum, the vessel is called the percolator, and the solution of active principles emerging from the percolator is called the percolate.

b. Principle of Operation.--Careful study of the definition of percolation will show that in the process advantage is taken of the attraction of gravitation, for it is hardly necessary to say that a liquid poured on top of a powder contained in a suitable utensil will gradually penetrate that powder in a downward direction, and if there is an orifice in the bottom of the vessel the descending liquid will emerge from the vessel, being attracted by gravity toward the center of the earth. This downward force of gravitation is aided by another force, merely a modification of the former, namely, the weight of the column of liquid above the powder. Mention of the latter is made here merely because the downward force varies according to the height of the column of liquid, whereas the force of gravitation remains unchanged. If this combined action of gravitation was the only force coming into operation, the process would be a simple one. However, there is an opposing force which comes into play during the process of percolation, namely, the upward force of capillarity.

Besides the force of gravity and its modification, the pressure of the column of liquid above, forcing the solvent downward through the drug, we have at the same time capillarity of the cells of the drug attracting the menstruum in the opposite direction. The moment the solution commences to emerge from the vessel, the capillary attraction of the cells tends to keep the liquid within the substance; therefore, acting against the force of gravity. Experience shows that the capillary force of the drug is usually greater than the simple gravitating force of the earth, for unless the gravitating force of the earth is reinforced by the height of the column of liquid above the powder, the liquid ceases to drop from the percolator. As the liquid passes through the drug on its downward course it penetrates the interior of each cell (provided the substance is in fine enough powder) and removes from the same the soluble constituents. Passing from one series it penetrates the next tier of cells, and, taking up more active principle, such solution continues until the solvent is saturated with the soluble principles of the drug. When once a satu-

rated solution, it mechanically passes through the rest of the drug, and finally emerges from the orifice of the bottom of the percolator, providing always that there is a sufficient column of the liquid to force it down. Its passage is followed by a fresh portion of the solvent, which passes through the same cells which it has formerly penetrated, removing the last vestiges of soluble matter, and finally emerging from the percolator also a saturated solution. In this way menstruum is continually poured on until the cells have been so completely exhausted of their soluble constituents that the final portion of the menstruum comes through devoid of color and taste, whereupon the drug is said to be exhausted.

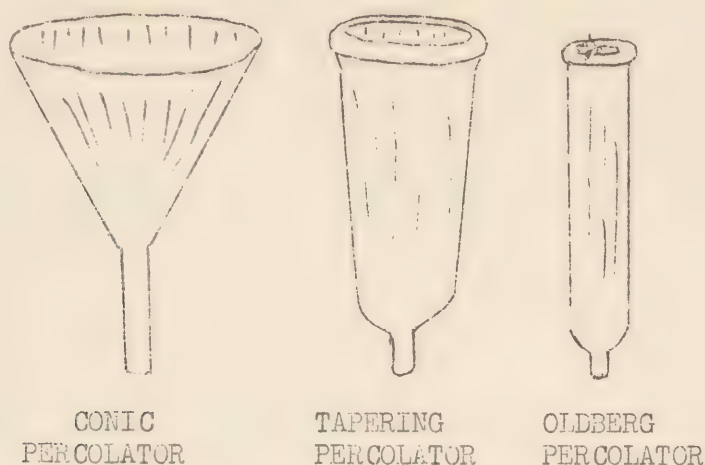
The great advantage percolation possesses over maceration is in the fact that, by means of percolation, we are enabled to completely remove every trace of soluble matter from a drug, inasmuch as the saturated solvent does not remain in contact with the drug (if the menstruum column is maintained), but passes from it, being followed by a fresh portion of solvent, which removes the remainder of the soluble principle.

c. Apparatus.--The utensil in which the drug is packed is called a percolator, and consists of a suitable cylindric vessel of metal or glass provided with an orifice at the bottom. In selecting percolators those of glass should be chosen when possible, metal percolators having the double disadvantage of being more easily attacked by acid or other substance which the menstruum or drug may contain and also the fact that their opacity prevents watching the operation. Tin percolators are convenient to use with processes using hot water.

(1) Shape of Percolators.--The simplest form of percolator is the conic (See Figure), consisting of an ordinary chemical funnel. This, however, offers too great a width of surface for the menstruum, which therefore, has a correspondingly smaller course to travel before emerging from the bottom of the percolator, and therefore, the familiar tapering percolator came into use (See Figure). At the present time the Oldberg (or more properly Diehl) cylindric percolator (See Figure) is very popular, for by means of it we are able to exhaust a drug far more thoroughly than in either a tapering or a conic percolator, from the simple fact, that each portion of menstruum has to travel through a larger amount of the drug before emerging from the percolator.

(2) The saturated solution, when emerging from the percolator, is called the percolate, and, of course, this must be collected in an appropriate vessel. For this purpose a wide-mouthed bottle, the receiving bottle, is usually employed. Elaborate forms of receiving bottles are on the market in which the graduations are engraved upon the glass. These, while presenting an elegant appearance, are scarcely necessary, as the pharmacist has many wide-mouthed bottles at his disposal, and he can usually graduate same by pouring in definite quantities of liquid from an accurate graduate, and marking amount by cutting with a file or on a strip of paper pasted along the length of the bottle (marking same with ink). The percolator must be supported on an appropriate stand, and for this purpose nothing can be better than

the retort stand (See Fig.) it being always understood, however, that the glass percolator must never come in contact with the iron ring, being protected from the same by covering the ring with paper or cloth.



d. Operation.--The process of percolation may be divided under the following headings: Comminution of the drug; moistening the same; packing in percolator (with maceration either before or after packing); pouring on the menstruum and collecting percolate until exhausted.

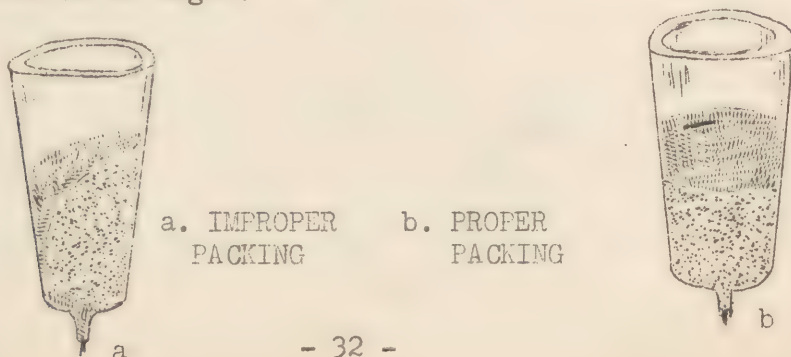
(1) Comminution.--Before percolating the drug it is essential that it be reduced to particles of more or less fineness, for the same reason that we comminute drugs before solution. As mentioned above in percolation it is essential that the drug be ground sufficiently fine to rupture all the cells of which it is composed, and this degree of fineness is dependent upon the structure of the drug, those drugs having small cells calling for a finer degree of comminution than those in which the cells are large. Thus ipecac must be powdered very finely whereas in glycyrrhiza the cells are large and a coarse powder can be utilized. This explains why the pharmacopoeia directs various degrees of fineness for the powder used in percolation. Another point regarding comminution of the drug is the rapidity or completeness of exhaustion. Thus, in percolating fluidextracts it is usually desirable to exhaust the drug with less menstruum than in preparing tinctures from the same drug, and in order to do this the drug used in percolating a fluidextract is generally directed to be in fine powder than that used in making the tincture.

(2) Moistening of the Drug.--Before packing the drug in the percolator it is directed to be moistened with menstruum, this being done because, when the drug comes in contact with the menstruum, the compressed dried cells are swollen to their normal size, and if this swelling occurred within the percolator, it would cause sufficient expansion to cause a stoppage of the operation. This moistening is accomplished by placing the drug in a suitable container, preferably of porcelain or stoneware, adding the required quantity of menstruum, and mixing same thoroughly with the drug by

stirring with a wooden paddle. After being moistened it should be allowed to remain for half an hour in order to complete the swelling.

(3) Packing of the Drug. (a) To receive this moistened powder a clean and absolutely dry percolator is prepared by placing in its neck a plug of absorbent cotton. Upon the plug of cotton the moistened powder is poured into the percolator, the usual rule being to place in the percolator about one-fourth of the powder at a time, and each fourth is firmly packed before the next portion is added. The packing is accomplished by means of a wooden plunger, and for this purpose a piece of wood will suffice, there being nothing better than a wooden potato-masher. The packing of the drug is a matter of skill and in order to do it successfully it is necessary to know the character of the drug and the menstruum. Drugs in finer powder are not, as a rule, packed so tightly as those of coarser powders, but the supreme test of the correct packing is the rapidity of the flow of the percolate. If the drug is packed too tightly, the percolate drops too slowly, and if too loosely, the percolate runs too rapidly to fairly exhaust the drug. In short, packing must be put down as chiefly a matter of experience. The nature of the menstruum also has an influence on the packing of the percolator. If the menstruum is pure alcohol, the drug can generally be packed more tightly than if it consists of water, and if glycerin is present in the menstruum, care should be taken not to pack the drug too tightly. It is hardly necessary to say that in packing the drug the pressure should be equal on all sides of the powder. If the drug on one side of the percolator is packed more loosely than on the other, it stands to reason that the menstruum will choose the easiest possible way and will run down the looser side, and therefore, the drug will be incompletely exhausted.

(b) All the drug being packed in the percolator, there is carefully placed above it a sheet of filter-paper which is held in place by a glass weight, any unused glass stopper answering the purpose. The object of the paper is to prevent the disturbance of the powder when the menstruum is poured in, the force of the fall of the liquid being apt to cause the rising of the powder to the surface of the menstruum. Whether the drug has been packed evenly on all sides is shown by the descent of the first menstruum, which should go down in a perfectly even ring, (Appended Figure). After the drug is packed in the percolator and enough menstruum has been poured in to fully penetrate the drug and to begin dropping from the percolator, the lower orifice is closed and the drug is directed by the pharmacopoeia to macerate within the percolator for a period specified in the official recipe, after which time the percolation is begun.



(4) Adding Menstruum.---The menstruum is, as mentioned above, the solvent used for extracting the active principles of the drug. The various menstrua directed by the pharmacopoeia for different drugs have been carefully selected with a view to using the particular solvent best adapted easily and speedily to remove the active principles of the drug under consideration. In some cases, however, the pharmacopoeial committee has been guided by practical commercial considerations, the rule being to choose as menstruum the cheapest solvent that will fully answer the purpose. Understanding this fact, the pharmacist should carefully follow the pharmacopoeial instructions, appreciating that when the United States Pharmacopoeia directs strong alcohol, it is because a weaker alcoholic menstruum will not answer the purpose. Usually the menstrua used in percolation are of various mixtures of alcohol and water; occasionally glycerin is directed to be added to the menstruum, this usually in cases of drugs containing large quantities of tannin. In the same way ammonia water is added to the menstruum in preparations of licorice, and ammonia or other alkalies for drugs containing pectin, while acids are used in the menstrua for drugs containing volatile alkaloids, such as conium, ergot, etc. Not all percolates are made with alcoholic menstrua.

(5) The Percolation.---The proper menstruum is poured upon the filter-paper above the powdered drug in the percolator, care being taken to pour it so as not to cause the floating of the paper. As the menstruum passes down through the drug, more is added to take its place, it being an unvaried rule that there should always be maintained a layer of menstruum above the surface of the drug, for, if the drug is exposed to the air, evaporation takes place from its surface, and fissures occur through which the menstruum added afterward will run, instead of through the entire surface of the drug. The menstruum poured in and passing through the drug should emerge from the percolator slowly and steadily, the rapidity being dependent entirely upon the quantity of the drug being manipulated; thus, the last pharmacopoeia directs a flow of ten drops a minute in percolating 1000 Gm. of drug for fluidextract, while for tinctures the flow is to be twenty drops a minute. It is needless to say, however, that this standard would be absurd if we were percolating 200 pounds of a drug and expecting, say, 100 gallons of the percolate.

(a) In most operations in the pharmacy, however, in which we deal with 200 to 1000 cc. of menstruum, the speed given above may be maintained, and a skillful operator aims to so pack his drug as regularly to attain this speed, and after some practice usually learns the art. In order, however, to insure the speed of percolation directed, the pharmacopoeia directs that the lower orifice of the percolator be closed with a cork through the perforation of which passes a glass tube which is fitted with a rubber tube, at least as long as the percolator and terminating with a second glass tube bent in the form of a "V". When the rubber tube is raised so that the outlet is above the surface of the menstruum in the percolator, it follows that no liquid will run out, whereas if it is lowered to its greatest depth, the liquid will run out very rapidly,

and, by raising or lowering the tube to its greatest height or greatest depth, the rapidity of the percolation can be regulated to a nicety. If it is desired to close the tube completely, a pinch-cock can be used, although if the tube is of sufficient length, this is scarcely necessary. In practice, the rubber tubing is not so convenient as it seems at first blush, as the several joints of the cork, the glass tube, and the rubber tube fittings are apt to leak unless very carefully prepared, making an unsightly and dirty process. If, therefore, the percolating tube is used, care should always be taken before percolation to see that the cork and rubber tubes do not leak by pouring water into the empty percolator, raising the tube to its greatest height, and allowing it to stand in that way for some time.

(6) Finishing Percolation. (a) In making preparations by percolation it is generally intended that the percolation be continued until the drug is exhausted, the word meaning in this case the removal from the drug of all its soluble constituents. There are several ways of proving the practical exhaustion of a drug, for in the operation, it is usually unnecessary to carry on percolation to the extreme point of removing every particle of soluble matter. If the drug is a bitter one, we generally say it is exhausted when the percolate comes through no longer bitter, even though it may be still impregnated with some of the coloring-matter residing in the drug, the latter being more tenacious and persistent of removal. In some cases the bitterness is so great that a large amount of menstruum will be necessary before every trace of bitterness is removed. An example of this is quassia, in which case we generally consider the drug exhausted when the percolate is almost free from bitterness.

(b) Tannin-bearing drugs are usually percolated until the percolate is free from astringency, whereas in odorous drugs the absence of odor from the percolate announces exhaustion.

(c) The residue left after percolation or maceration is called the marc, and in both percolation and maceration it retains a considerable amount of moisture. As mentioned under Maceration, in the latter case the moist liquid is the finished full strength tincture, and the marc should always be expressed, else the yield of tincture will be lessened. In percolation the marc is moist with the menstruum, hence there is no loss so far as finished tincture is concerned, but the loss of menstruum is excessive.

STERILIZATION

24. Definition.--The term sterilization as used in medical or pharmaceutical practice, means a process whereby the destruction or removal of microscopic living organisms and their spores is accomplished.

25. The uses of sterilization as applied by pharmacy technicians are:

- a. For the preparation of solutions for hypodermic injection.
- b. For the preparation of aseptic medicines for internal or external administration.
- c. For the preparation of solutions, dressings, etc., for surgical use.
- d. For the preservation of preparation of substances through the destruction of organisms which would otherwise cause deterioration or decomposition.

26. METHODS OF STERILIZATION.-- a. There are various methods whereby sterilizations may be accomplished, and it is necessary that the technician shall select in each case the one which is most suitable. From the viewpoint of the pharmacist it is important to know:

(1) That most micro-organisms multiply rapidly at temperatures between 20° and 40° centigrade (68° and 104° F.) if there is some nutritive material present.

(2) If contaminated substances are maintained at a temperature of freezing (0° centigrade or 32° F) or below, the development of organisms is retarded, but they are not necessarily destroyed

(3) All classes of micro-organisms, whether they are bacteria, molds, yeasts, diatoms, or protozoa, also their spores, may be destroyed by practically the same procedure. Any method which will kill all bacterial spores will also destroy any form of life.

(4) Bacteria may develop in almost any substance if sufficient moisture and atmospheric oxygen are present and the temperature is favorable. Some bacteria are anaerobic, that is, they do not require oxygen, and will not survive in its presence.

(5) Bottles, flasks, test tubes, etc., stoppered with purified cotton (which has been wrapped in gauze to prevent contamination from filaments of cotton, and afterwards passed quickly through a flame to burn off any loose filament on the gauze), then sterilized and kept dried, may be maintained in a sterile condition for an indefinite period. Before opening, however, the orifice should be sterilized by passing it through a Bunsen flame. The exterior of the plug is burnt off at the same time, thus destroying bacteria which may have lodged there.

(6) It is desirable that the pharmacist should operate, while preparing sterilized solutions, ointments, etc., under conditions which will avoid the possibility of a contamination of the material, apparatus, etc., by the falling of dust during the operation.

(7) Bottles containing sterilized liquids to be dispensed should be closed with rubber stoppers which have been previously sterilized by boiling for 10 minutes in a 5% phenol solution, then

thoroughly rinsed in boiling water and stored in alcohol until used. These should be handled only with large forceps, the tips of which have been sterilized by heating in a Bunsen flame.

b. Sterilization may be accomplished by the following processes.

Process A - Direct Flame (Flaming): Objects such as platinum needles; the metallic orifice of a Berkefeld or similar filter; the points of tweezers or forceps; spatulas and any metallic ware; the lip of a bottle, tube, or a flask; the tip of an ampul or any stone ware or glassware that is not liable to be broken by the open flame, are quickly sterilized by rotating for an instant within the flame, or by playing the Bunsen flame on them a few times.

Process B - Dry Heat: Place dry objects in a suitable oven, and maintain a temperature between 160° centigrade and a 190° centigrade for at least one hour. Cotton stoppered glassware is usually heated in the oven for 2 hours at 160° to a 170° centigrade, cotton plugs will char above 190° centigrade.

Before exposing glassware to the heat of the dry sterilizer, cleanse it thoroughly to remove all organic matter.

Glassware which is not cotton-stoppered and other objects are to be suitably wrapped in paper or placed in metallic containers so that they may remain in a sterile condition after sterilization.

Process C - Steam Under Pressure: - Materials that will not be injured by temperatures of 110° to 130° centigrade may be sterilized in a steam chamber or autoclave by means of steam under pressure in the absence of air. The usual steam pressure and corresponding length of time required for adequate sterilization is as follows:

- 10 pound pressure (114° centigrade) for 30 minutes.
- 15 pound pressure (120° centigrade) for 20 minutes.
- 20 pound pressure (127° centigrade) for 15 minutes.

Care must be exercised in maintaining an adequate water supply in the sterilizer at all times and preventing an unnecessary large amount of steam to escape during the time that the sterilizer is in operation. All air must be removed from the sterilizing chamber in order to operate the autoclave efficiently and at the end of the operation the pressure must be allowed to return to normal automatically and the temperature should preferably become normal before making any attempt to open the chamber. If solutions are being sterilized in containers which are not tightly stoppered, there is a possibility of a marked loss of the liquid (5 to 10%), making it necessary to readjust the solution to its original volume with sterile water after removal from the sterilizer. If large quantities of liquids are being sterilized under pressure, additional time should be allowed since it will take several minutes to heat the large volume of material to the sterilization temperature. The pressure should be developed as quickly as possible and the air

valve closed as soon as steam begins to escape in order to obtain maximum efficiency and to prevent blowing of stoppers from containers.

Process D - Moist Heat at 100° Centigrade (Fractional Sterilization, Intermittent Sterilization): - Solutions that contain organic matter of nutritive nature and undergo deterioration in the higher temperatures of the autoclave, but are not harmed by a temperature of 100° centigrade, may be sterilized in an Arnold sterilizer, or in a covered kettle or boiler. The solution, either in sealed ampuls or in small, suitably stoppered containers, is placed in the chamber of the sterilizer, which is then filled with live steam by boiling the water in the bottom of the sterilizer. After the temperature within the chamber has reached approximately 100° centigrade, it is maintained for 30 minutes at this temperature. The process in the sterilizer is repeated on the second day and on the third day, the solution being kept at room temperature during the periods between the heatings.

Process E - Fractional Sterilization at Low Temperature:-- Solutions containing organic matter of a nutritive nature that deteriorate at a temperature of 100° centigrade but are not harmed by somewhat lower temperatures, may be treated as described under Process D, except that the temperature in the sterilizing chamber is maintained at 60° to 70° centigrade. This process does not insure positive sterility, and a solution so treated, unless it is bacteriostatic, shall contain a bactericidal or bacteriostatic agent.

Process F - Filtration: - The army pharmacy technician will not ordinarily use this process so it is sufficient to say that solutions that deteriorate when heated may be passed through a sterile clay filter candle such as is used in the Berkefeld or Chamberland type of filter, or through any sterile filter that will sterilize the solution and not cause deterioration.

c. (1) All liquids which are to be injected intravenously or hypodermically should be sterile and clear. The remedies given in these ways are largely biologic products or alkaloids, and many of these cannot be heated at 100° centigrade without partial or complete decomposition. Biologic products comes from the manufacture in a sterile condition, but in diluting them sterile physiologic salt solutions should be used. Some sort of alkaloids, and some organic compounds may be boiled in water, as morphine, codeine, dionin, quinine, caffeine, emetine, strychnine, and pilocarpine, but even these are preferably sterilized by the fractional method.

(2) Utensils used in sterilizing solutions, containers, and stoppers should first be made aseptic. Glassware, such as funnels, bottles, and jars, should be washed with an alkali followed by an acid and then distilled water, then dried and heated to 170° centigrade for an hour and afterwards protected from the dust. Glycerin, olive oil, paraffin oil, and ointment bases such as lard, wool fat, and petrolatum, can be heated to 120° centigrade for 2 hours without decomposition.

(3) Sugar or glycerin and alcohol are used as preservatives. These should be present in sufficient amount to have a desired effect, as in small amounts they may aid decomposition. Many organic preparations are preserved by the presence of 20% of alcohol and some with a smaller amount. Sugar to be a preservative should be in nearly saturated solution.



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FILE NO. 245

PHARMACY -- GALENICAL
For Pharmacy Technicians
Vol. II
Part I

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GALENICAL PHARMACY

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WATERS

1. DEFINITION -- The class of preparations termed waters are known also as medicated, aromatic, or distilled waters, and may be simply defined as aqueous solutions of volatile substances. Aromatic Waters are saturated solutions (unless otherwise specified) of volatile oils or other aromatic or volatile substances in distilled water. They should be clear and free from solid impurities. Their odor and taste are similar to those of the drugs or volatile substances from which they are prepared, and the preparations should be free from empyreumatic (smoke-like) and other foreign odors. Strong light, or freezing hastens their decomposition. The tendency for microscopic organisms to grow in most aromatic waters is retarded if purified cotton is used as a stopper for the containers in which they are stored.

a. The volatile oils from which aromatic waters are to be made should be of the best quality and in perfect condition if the finest flavors are to be obtained. The Pharmacopoeia permits most of the aromatic waters to be made by any of the processes, the detailed formulas which follow indicating the exceptions.

b. The volatile substances used in the preparation of waters are either solid, liquid, or gaseous, and the following methods have been employed in effecting their solution: 1, simple solution in cold distilled water, with or without filtration through paper; 2, filtration with the aid of an absorbent powder; 3, filtration with the aid of pulped or shredded filter paper; 4, distillation.

c. Most of the medicated waters are solutions of aromatic volatile oils and are used as pleasant vehicles and solvents for the administration of various remedies.

2. METHODS OF PREPARATION -- a. SIMPLE SOLUTION IN COLD WATER -- This method is followed when the proportion of the volatile substance is small enough to dissolve easily in the quantity of water required, as in the formerly official Bitter Almond Water. It is also recommended when an excess of a volatile liquid is added and after repeated agitation and standing for about twelve hours, the product is filtered through a paper filter which has been thoroughly washed with distilled water. The method of making medicated waters by agitation with an excess of a volatile oil, permitting the excess to remain and drawing off the water as required is not recommended on account of the liability of the oil to deteriorate through exposure to light and air. In the case of gaseous solutions, the gas is passed through the water until a solution of the desired strength is obtained.

b. FILTRATION WITH THE AID OF AN ABSORBENT POWDER is the process most frequently employed; the object of using the powder is thoroughly to divide the oil, or volatile substance, and thus expose a greater surface, so that water in filtering through it may become completely saturated. Magnesium carbonate was formerly employed for this purpose but its slight solubility in water, causing the latter to show a trace of alkalinity, renders it unfit for use. Calcium phosphate, kaolin, powdered glass, silica, powdered pumice-stone, charcoal, precipitated

chalk, etc., have been suggested as substitutes, but there are quite as strong objections to these as to the magnesium carbonate. The Pharmacopoeia recommends the use of purified talc, for this purpose, with purified siliceous earth as an alternative, although the latter has not proved satisfactory for waters. It is, however, an excellent filtering medium for elixirs.

When solutions of alkaloids or of silver nitrate are prescribed, distilled water alone and not an aromatic water should be used.

c. FILTRATION WITH THE AID OF PULPED OR SHREDDED FILTER PAPER-- This process is permitted by the U.S.P. and consists in dropping the volatile oil upon white filter paper or filter paper pulp, tearing this into shreds, transferring it to a flask or stoneware jug, adding distilled water in portions, and shaking it thoroughly. The liquid is then filtered through paper and the quantity adjusted by pouring distilled water through the filter.

d. DISTILLATION-- The process of making waters by distillation is the most ancient of all processes of this class of preparations and in many instances is said to give a better product than any other method. As the pharmacy technician will not be called upon to prepare Waters by this process no explanation will be given here. Among the official waters several are to be made only by distillation. They are Stronger Rose Water, Orange Flower Water of the Pharmacopoeia and Hamamelis Water of the National Formulary.

3. PRESERVATION -- Distilled waters should not be made in larger quantities than can be used within a reasonable time, as they deteriorate when long kept, a flocculent precipitate forming and all traces of their usually agreeable odor disappearing. The use of recently boiled, distilled water is preferable, to avoid as far as possible the presence of microorganisms in the water used, as it is well known that ordinary distilled water is usually contaminated by the presence of such growths. The freshly prepared water may be introduced into a sterilized bottle with a side opening to which a sterilized rubber tube with a pinchcock is attached, and the bottle then closed with a pledget of sterilized cotton. This will materially assist in the preservation of the water. It usually suffices, however, to preserve the medicated water in small bottles, which are completely filled, tightly sealed, and kept in a cool, dark place. No preservative should be added to medicated waters and if they become cloudy or otherwise deteriorate, they should be discarded.

4. The U.S.P. has introduced the following general processes by which most of the official waters are to be made, the choice being left to the pharmacy technician. Theoretically, all processes produce identical products, but in practice the distillation method yields quite a differently flavored water. However, most pharmacists use one of the other processes and if care has been taken in the selection of the volatile oil and in the preservation of the product, the waters are satisfactory.

a. Distillation -- Place the odoriferous portion of the plant or drug from which the Aromatic Water is to be prepared in a suitable still with sufficient distilled water, and distil most of the water, carefully avoiding the development of empyreumatic odors through the charring or scorching of the substances. Separate the excess of oil and preserve or use the clear aqueous portion, filtered if necessary.

b. Solution --

The Volatile Oil, or Other Specified Volatile Substance... 2 Gm, or 2 cc.
Distilled Water, a sufficient quantity,

To make. 1000 cc.

Shake the volatile substance (suitably comminuted if a solid) with 1000 cc. of distilled water in a capacious bottle, and repeat the shaking several times during a period of about fifteen minutes. Set the mixture aside for twelve hours or over night, filter through wetted filter paper, and pass enough distilled water through the filter to make the product measure 1000 cc.

c. Alternative Solution Method -- The following method for preparing Aromatic Waters by solution is alternative with the method just prescribed. Thoroughly incorporate the volatile oil (or the suitably comminuted volatile solid) with 15 Gm. of purified talc or with a sufficient quantity of purified siliceous earth or pulped filter paper. Add 1000 cc. of distilled water and thoroughly agitate the mixture several times during ten minutes. Then filter the mixture, returning the first portions, if necessary, to obtain a clear filtrate and add enough distilled water through the filter to make the product measure 1000 cc.

AQUA CAMPHORAE, USP, Camphor Water

(Aq. Camph.)

Camphor Water is a saturated solution of camphor in distilled water, prepared by solution of the camphor as described under Paragraph 4.

N. F. Preparations -- Mistura Camphorae Acida, Mistura Camphorae Aromatica.

Uses -- Frequently employed as a vehicle in eye and mouth washes; also as a mild nerve sedative.

Average Dose -- 10 cc.

AQUA CHLOROFORMI USP Chloroform Water

(Aq. Chlorof.)

Chloroform
Distilled Water, each a sufficient quantity.

To a convenient quantity of distilled water contained in a dark amber-colored bottle, add enough chloroform to maintain a slight excess after the mixture has been repeatedly and thoroughly shaken.

When Chloroform Water is to be dispensed, decant the quantity required, refill the bottle with distilled water, and saturate it by thorough agitation, taking care that there is always an excess of chloroform present.

Storage -- Preserve Chloroform Water in well-closed containers and protected from light.

Uses -- It is employed as a sedative in cough mixtures and as a vehicle for administering active remedies. Because of its antiseptic value it sometimes replaces water as a menstruum, the chloroform being evaporated during the concentration of the percolate. The saturated water contains about 0.5% of chloroform.

Average Dose -- 15 cc.

AQUA CINNAMOMI USP Cinnamon Water

(Aq. Cinnam.)

Cinnamon Water is a saturated solution of oil of cinnamon in distilled water, prepared by one of the processes described under Paragraph 4.

U.S.P. Preparations -- Infusum Digitalis, Mistura Cretae.

N. F. Preparations -- Liquor Ferri Albuminati; Syrupus Cinnamomi; Syrupus Ipecacuanhae et Opii; Tinctura Ferri Pomata; Tinctura Rhei Aquosa.

Uses -- A pleasantly flavored vehicle.

Average Dose -- 15 cc.

AQUA MENTHAE PIPERITAE, USP, Peppermint Water

(Aq. Menth. Pip.)

Peppermint Water is a saturated solution of oil of peppermint in distilled water, prepared by one of the processes described under Paragraph 4.

AQUA AMMONIAE, USP, Ammonia Water

(Aq. Ammon. -- Solution of Ammonium Hydroxide)

Ammonia Water is an aqueous solution of ammonia (NH_3) containing in each 100 cc., not less than 9 Gm. and not more than 10 Gm. of NH_3 . This solution deteriorates rapidly in open containers.

Ammonia Water may be prepared as follows:

Stronger Ammonia Water.	398 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Mix the ingredients.

Preparation -- Ammonia is produced commercially by the destructive distillation of waste animal matter, by direct synthesis of atmospheric nitrogen and hydrogen, and by treating the ammonia liquor obtained from gas works with milk of lime and heating. Ammonia gas may be expelled from ammonia water by simply applying heat to the solution.

Description and Physical Properties -- A colorless, transparent liquid, having a very pungent, characteristic odor. Specific Gravity: about 0.957 at 25° C.

Tests for Identity -- Ammonia Water is strongly alkaline to litmus paper. Dense, white fumes are produced on bringing a glass rod wet with hydrochloric acid near the surface of Ammonia Water.

U.S.P. Preparations -- Spiritus Ammoniae Aromaticus.

N.F. Preparations -- Elixir Ammoniae Valeratis; Fluidextractum Senegae; Linimentum Ammoniae; Linimentum Saponato-Camphoratum; Liquor Carmini; Magma Busmuthi, Spiritus Ammonii Anisatus; Syrupus Senegae.

Storage -- Preserve Ammonia Water in a cool place, in glass stoppered or rubber stoppered bottles made of hard glass, free from lead.

Uses -- Ammonia Water is occasionally employed hypodermically as a circulatory stimulant; it is also used for syncopal attacks by inhaling. It is rarely given by mouth, the aromatic spirit being preferred. The dose is 0.6 to 1.2 cc., largely diluted. Externally, it is caustic and stimulating. It is a common ingredient in stimulating liniments. Pharmaceutically, ammonia water is frequently used to precipitate iron salts by combining with the acid radicals, ferric hydroxide being thrown down. Its advantage over the fixed alkalies consists in its volatility, any excess being readily detected by the odor. It is largely used for cleaning fabrics. The old name spirits of hartshorn is derived from an early origin of the product, as it was made by collecting the gases resulting from the destructive distillation of the horns of the variety of European deer known as the hart. The name is almost entirely supplanted by the modern name "ammonia" which originated from the fact that sal ammoniac was obtained as a residue from the evaporation and decomposition of camels' urine in the hot sands of the Libyan Desert, near the temple of Ammon.

AQUA AMMONIAE FORTIOR. USP Stronger Ammonia Water
(Aq. Ammon. Fort.)

Stronger Ammonia Water is an aqueous solution of ammonia (NH_3), containing not less than 27 per cent and not more than 29 per cent by weight of (NH_3 17.03). This solution deteriorates rapidly in open containers.

Caution -- Great care should be used in handling the liquid because of its caustic and irritating properties.

Preparation -- Stronger ammonia water is prepared as mentioned under ammonia water, the only difference being that of relative strength.

Description and Physical Properties -- A colorless, transparent liquid, having an excessively pungent, characteristic odor, and a very caustic and alkaline taste. Stronger Ammonia Water must never be tasted or smelled unless greatly diluted.

U.S.P. Preparations -- Aqua Ammoniae.

N.F. Preparations -- The Petroxolins.

Storage -- Same as for Ammonia Water.

Uses -- This liquid is used only for chemical and pharmaceutical purposes and for making ammonia water by dilution and in the preparation of the petroxolins of the N. F., where it forms an ammonium oleate, also in spirit of ammonia. It is too strong for internal administration.

AQUA DESTILLATA STERILISATA USP Sterilized Distilled Water
(Aq. Dest. Steril.)

Water, freshly distilled, a sufficient quantity.

Place freshly distilled water, neutral to litmus paper, in sterilized containers of insoluble glass, having a capacity of not over 1000 cc. each. Stopper the containers with plugs of purified non-absorbent cotton, wrapped in gauze. Fasten stout, non-absorbent paper or tinfoil over the top of the plug and the lip of the flask, and sterilize in an autoclave, under steam pressure, giving a temperature of not less than 115° C., for thirty minutes.

If an autoclave is not available, close the mouth of the flask containing the freshly distilled water with a plug of purified non-absorbent cotton wrapped in gauze, boil the contents actively for not less than one hour, and allow the water to cool without removing the cotton plug. Until ready for use, protect the mouth of the flask and the plug from contamination through dust by wrapping the top of the flask tightly with paper. Sterilized Distilled Water meets the requirements of the tests for purity under Aqua Destillate. (See USP)

Storage -- Sterilized Distilled Water, when stored in a stoppered container, should be used within twenty-four hours after its distillation. If stored in a hermetically-sealed container, it should conform to the tests for sterility of liquids, USP XI, Page 469.

The USP XI contains no test for organic matter under distilled water as is given under redistilled water. It does, however, require that the water be "freshly distilled" and that the sterilized distilled water should not be used after twenty-four hours. "Freshly distilled," according to clinical evidence must also be interpreted as meaning within one or two hours after distillation. If these requirements are observed and if the preparations are also protected from contamination as directed by the USP, a safe and satisfactory product will result, free from pyrogenic contamination.

The USP states that hermetically sealed containers of distilled water must be sterile and it is understood that the sterilized water in flasks is also sterile, this being guaranteed by a strict compliance with the USP specifications.

AROMATIC WATERS

Definition:

How are Aromatic Waters prepared?

Why must distilled water be used?

Why should Aromatic Waters be filtered through "wetted filter paper?"

When talc is used -- what is its purpose.

State the use in general of aromatic waters.

What effect would freezing have on an Aromatic Water?

How may the development of fungus growth best be retarded?

Storage

AQUA CAMPHORAE

O. E. T. U. S. P. or N. F.

Syn. Abbr.

Definition:

Prepare 120 cc. using talc. Show Calculations

Formula:

Define comminution.

How should the camphor be powdered?

State the solubilities of camphor.

State in grams the amount of camphor in one fluid ounce of this water?

Uses and doses.

Physical properties.

AQUA CHLOROFORMI

O. E. T. U. S. P. or N. F.
Syn. Abbr.
Prepare 120 cc. Show Calculations

Formula:

Why is this water not filtered?

Use and dose.

Explain the special precaution for preserving this water.

Physical properties.

AQUA CINNAMOMI

O. E. T. U. S. P. or N. F.

Syn. Abbr.

Prepare 120 cc. (Using pulped filter paper). Show calculations

Formula:

Why does Cinnamon water become acid?

Why does Cinnamon Water become bitter on standing?

Physical properties.

O. E. T. U. S. P. or N. F.

Syn. Abbr.

Prepare 120 cc.

Show calculations

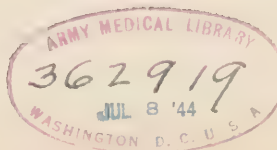
Formula:

Define a saturated solution.

Is a saturated solution such as the above capable of dissolving another solute?

Define filtration.

Description and physical properties.



AQUA AMMONIAE.

O. E. T. U.S.P. or N. F.

Syn. Abbr.

Definition:

Prepare 90 cc.

Show Calculations

Formula:

List and give the percentage strengths of the official ammonia waters.

What is formed on the containers when the hydrochloric acid bottle is placed next to the ammonia water bottle? Show by chemical equation.

Storage:

Use:

O. E. T. U. S. P. or N. F.

Syn. Abbr.

Prepare 100 cc.

Show calculations.

Formula:

If used intravenously how long should the water be stored and why?

How should the finished products be tested for sterility?

Why are plugs of non-absorbent cotton used to close the mouth of the flask?

Why must insoluble glass containers be used?

Storage.

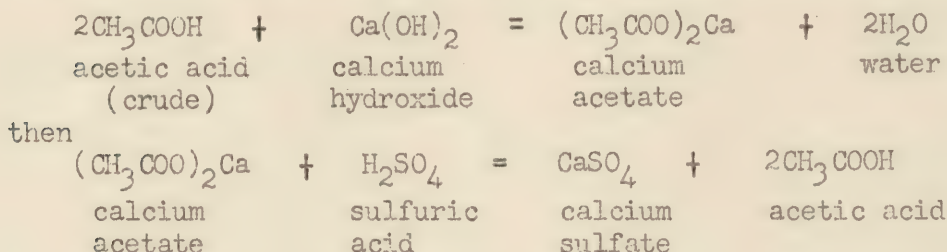
Description and physical properties.

ACIDS

ACIDUM ACETICUM USP Acetic Acid

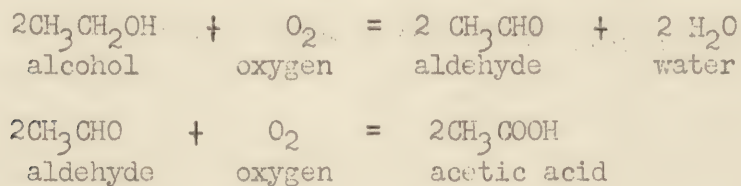
Acetic Acid is an aqueous solution containing not less than 36% and not more than 37% of $\text{HC}_2\text{H}_3\text{O}_2 = 60.03$

Preparation -- Acetic acid is an important product of the hard wood destructive distillation industry. It is obtained commercially by neutralizing the crude wood distillate called pyroligneous acid with milk of lime, decomposing the calcium acetate with sulfuric acid, and distilling off the liberated acetic acid. The reactions that take place in this separation are shown in the following equations:

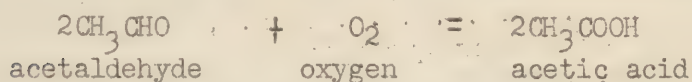
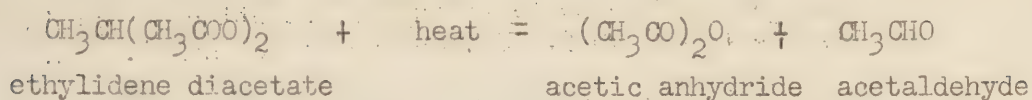
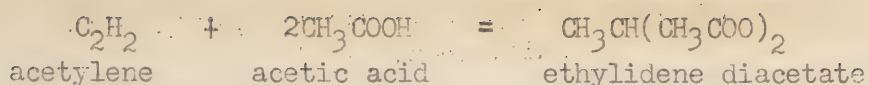


The temperature used for distilling wood may be much less than that necessary to produce charcoal. The advantages of this process are that the production of empyreumatic substances, which constitute the most objectionable impurities in the commercial acid, is largely curtailed, the process being at the same time more economical, as the residue of slightly darkened wood is more valuable than the completely charred carbon left by the ordinary process.

Acetic acid is also made by distilling vinegar, a liquid made by the oxidation of dilute alcoholic liquids, such as cider, wine, etc. It is also made by mixing alcohol with water in the proportion of eight parts of the former to nine-two parts of the latter, and then pouring it upon beech wood shavings which have been impregnated with cultures of Mycoderma aceti. As the alcoholic liquid trickles through, it is oxidized by the action of the air, through the agency of the microorganisms. Aldehyde is an intermediate product. This "quick vinegar" process is also employed for the acetification of "hard cider"



The more concentrated acetic acids are also made synthetically from acetylene. If the latter is passed into acetic acid containing a metallic catalyst, ethylidene diacetate is produced which yields, upon heating, acetic anhydride, and acetaldehyde. The latter is then oxidized by the oxygen in air to form acetic acid. The reactions are as follows:



The acetic anhydride obtained in the above reaction may be converted into two molecules of acetic acid by hydration with water.

Various strengths of acetic acid are found in commerce -- the official acid (36 to 37 per cent), which has the sp. gr. 1.045 at 25° C., stronger acids of 60 to 80% strength, which may be used economically for making the weaker acid, and also the No. 8 acid, as it is called (30%), which is still used; the latter has the sp. gr. 1.038 at 25° C. and is weaker than the official acid. It is termed "No. 8" because it was formerly used in the proportion of one part in eight to make the ordinary diluted acetic acid, equivalent in strength to distilled vinegar.

Acetates -- When warmed with concentrated sulfuric acid, acetates evolve acetic acid. If acetic acid or an acetate is warmed with sulfuric acid and alcohol, the characteristic fragrant odor of ethyl acetate is evolved. With neutral solutions of acetates, ferric chloride T. S. produces a deep red color which is destroyed by the addition of mineral acids.

Description and Physical Properties -- A clear, colorless liquid, having a strong, characteristic odor, and a sharply acid taste. Acetic acid is miscible with water, with alcohol, and with glycerin.

Tests for Identity -- Acetic Acid is strongly acid to litmus paper and responds to the tests for acetate.

USP Preparations -- Acidum Aceticum Dilutum

NF Preparations -- Linimentum Terebinthinae Aceticum; Liquor Alumini Subacetatis; Tinctura Delphinii Acetica.

Storage -- Preserve Acetic Acid in glass-stoppered bottles.

Uses -- Acetic acid is used in pharmacy as a solvent and menstruum, and for making the diluted acetic acid. The crude acetic acid called pyroligneous acid is sometimes put up under the name of "liquid smoke" and sold for the purpose of preserving meat, fish, etc., which are dipped therein and then dried, instead of subjecting them to the customary smoking process. This use of pyroligneous acid is prohibited by most food laws. Acetic acid is also used as a starting point in the manufacture of many other organic compounds. It also finds many applications in the textile industry.

ACIDUM ACETICUM DILUTUM USP Diluted Acetic Acid
(Acid. Acet. Dil.)

Diluted Acetic Acid is an aqueous solution containing, in each 100 cc., not less than 5.7 Gm. and not more than 6.3 Gm. of $\text{HC}_2\text{H}_3\text{O}_2$.

Diluted Acetic Acid may be prepared as follows:

Acetic Acid. 158 cc.
Distilled Water, a sufficient quantity,
To make. 1000 cc.
Mix the ingredients.

Description and Physical Properties -- A clear, colorless liquid, having a characteristic odor. Diluted Acetic Acid is miscible with water and with alcohol.

Tests for Identity -- Same as for Acetic Acid.

USP Preparations -- Acetum Scillae, Liquor Ammonii Acetatis.

Storage -- Preserve Diluted Acetic Acid in glass-stoppered bottles.

Uses -- Diluted Acetic Acid is superior to vinegar as a menstruum, and is used officially because of its greater purity, more uniform strength, and freedom from color. It is of service as an astringent, as in sunburn, and as a styptic. The dose is 2 cc.

THE INORGANIC ACIDS. -- Practical Points in Handling Strong Acids -- The strong inorganic acids are never made by the pharmacist for commercial purposes, as they can be manufactured much more economically upon the large scale. They are corrosive in their action, and must be handled very cautiously to avoid personal injury. They are usually sent out by manufacturers in one pound, or in five-pint, glass stoppered bottles, or in carboys holding about ten gallons. One of the common annoyances is the liability of the glass stopper to become so tightly fastened in the neck of the bottle that it is extracted with difficulty. Should this occur, place the container in a vessel, such as an enameled kettle, before attempting to force the stopper. This will prevent a serious accident, should the bottle be broken. Frequently the stopper may be removed by grasping the bottle firmly, and after cleaning off the lute, carefully tapping the stopper gently with a stick of wood. If very moderate measures do not succeed, the neck of the bottle may be cautiously heated by wrapping it in a cloth wet with hot water, or by means of a spirit-lamp or Bunsen burner with a low flame, passing the flame quickly around it several times so that it will be uniformly heated. This will cause expansion of the neck, and if the heating is not unduly prolonged so that the outer surface of the stopper becomes correspondingly heated, the stopper may be easily extracted. If these means do not succeed, the bottle should be inverted in a vessel of warm water to a depth sufficient to cover the neck and allowed to remain several hours, strong turning of the stopper may then loosen it. Corks should not be used as stoppers for the strong acids, because of the corrosive action of the latter -- the cork almost invariably contaminating and discoloring the acid.

Quality of Commercial Acids -- Several grades of acids are found in commerce. The designation "U. S. P." is attached to those

which are of the quality indicated by the U. S. Pharmacopoeia for use in making preparations and for tests, etc. The designation "Chemically Pure" is frequently meaningless, and acids are now sold as of "U.S.P." or "Reagent" quality or as "Analyzed." The latter means that the impurities which are present are expressed in terms of actual amounts upon the label of each package of acid. Too much importance cannot be attached to the duty of procuring pure and strong acids. Loss and annoyance in making many preparations will surely follow the use of acids deficient in strength and purity.

Strength of the Official Acids -- The official inorganic acids are aqueous solutions of the respective acids and there is no uniformity in strength. For instance, hydrochloric acid contains from 35 to 37 per cent of HCl, nitric acid contains from 67 to 70 per cent of HNO_3 , and sulfuric acid contains from 94 to 98 per cent of H_2SO_4 . These respective strengths are the most practical from the commercial standpoint. On the other hand, the diluted acids are purposely made uniform -- diluted hydriodic, hydrochloric, phosphoric, and sulfuric acids each containing from 9.5 to 10.5 Gm. of acid in each 100 cc. of what is sometimes referred to as the absolute acid. Diluted acetic acid 5.7 Gm. to 6.3 Gm. per 100 cc. and diluted hydrocyanic acid of the N. F. (1.9 to 2.1 per cent) are exceptions.

Medicinal Properties -- The inorganic acids are generally tonic and refrigerant when administered in a diluted condition; externally, if applied undiluted, they are caustic and corrosive and should be used with the greatest care. One of the principal difficulties attendant upon the internal administration of acids is their injurious action upon the teeth. To avoid the destructive contact with the enamel, the acid should be highly diluted and should be taken through a narrow glass tube.

ACIDUM HYDROCHLORICUM USP Hydrochloric Acid
(Acid. Hydrochl.)

Hydrochloric Acid is an aqueous solution containing not less than 35 per cent and not more than 37 per cent of HCl (36.47).

Preparation -- Hydrochloric acid, the only known compound of chlorine and hydrogen, is made on a very large scale both abroad and in this country. It is obtained as a by-product resulting from the manufacture of soda-ash, by decomposing common salt heated to a high temperature with sulfuric acid. Sodium sulfate is formed, and gaseous hydrochloric acid is liberated. The latter is conducted into a tall tower filled with coke, called a coke scrubber, the ascending gas being met by a descending flow of water, which readily dissolves the gas.

Hydrochloric acid is also a by-product in the electrolytic production of sodium hydroxide from sodium chloride. The liberated chlorine is then converted to hydrochloric acid either by heating with steam to 1000°C . in the presence of an excess of carbon, or by directly combining it with hydrogen, which is also obtained in the electrolytic production of sodium hydroxide.

The yellow color of the common acid (muriatic acid) is generally due to organic substances or a trace of iron. This variety is sometimes called for by plumbers and tinsmiths under the very old name of spirit of salt.

The white fumes produced when the acid is exposed to the air are caused by the gaseous acid combining with the moisture in the air, and also with a trace of ammonia usually present, forming ammonium chloride.

Description and Physical Properties -- A colorless, fuming liquid having a pungent odor. The fumes and odor of the Acid disappear when diluted with 2 volumes of water.

Tests for Identity -- It is strongly acid to litmus paper even when highly diluted. When Hydrochloric Acid is heated with manganese dioxide, chlorine is evolved. Hydrochloric Acid responds to the tests for chloride.

History -- This acid was first prepared commercially by Glauber in the seventeenth century by distilling sea salt with sulfuric acid, hence the common name Spirit of Salt which was attached to it for many years.

USP Preparations -- Acidum Hydrochloricum Dilutum; Resina Podophylli.

NF Preparations -- Acidum Nitrohydrochloricum; Acidum Nitrohydrochloricum Dilutum; Tinctura Sanguinariae.

Storage -- Preserve Hydrochloric Acid in glass-stoppered bottles.

Uses -- Hydrochloric Acid is largely used in making chlorides and other preparations. Medicinally it is usually prescribed in the diluted form in stomach disorders; also very dilute solutions of hydrochloric acid (1 in 1500) are administered intravenously.

ACIDUM HYDROCHLORICUM DILUTUM USP Diluted Hydrochloric Acid
(Acid. Hydrochlor. Dil.)

Diluted Hydrochloric Acid is an aqueous solution containing in each 100 cc., not less than 9.5 Gm. and not more than 10.5 Gm. of HCl.

Diluted Hydrochloric Acid may be prepared as follows:

Hydrochloric Acid.	236cc.
Distilled Water, a sufficient quantity,	
To make.	1000cc.

Mix the ingredients.

Description and Physical Properties -- A colorless, odorless liquid.

Tests for Identity and Purity -- Same as for Acidum Hydrochloricum.

USP Preparations -- Liquor Acidi Arsenosi.

N. F. Preparations -- Elixir Pepsini; Glyceritum Pepsini; Liquor Pepsini.

Storage -- Preserve Diluted Hydrochloric Acid in glass-stoppered bottles.

Uses -- Diluted hydrochloric acid is used in the treatment

of certain types of dyspepsia in doses of 1 to 2 cc., largely diluted with water. It should be drawn through a glass tube or straw, to avoid injury to the teeth.

ACIDUM SULFURICUM USP Sulfuric Acid

(Acid. Sulfuric. -- Sulphuric Acid)

Sulfuric acid contains not less than 94 per cent and not more than 98 per cent of H_2SO_4 (98.08)

Caution -- When mixing Sulfuric Acid with other liquids the Acid should always be added to the diluent, and great caution should be observed.

Preparation -- Sulfuric acid is produced either by the "lead chamber process" or by the "contact process." The term "lead chamber process" is derived from the fact that the reaction takes place in lead-lined rooms. According to one theory, which has been recognized for many years, the sulfur dioxide SO_2 , obtained by burning sulfur or iron pyrites, FeS_2 is allowed to mix with the nitrous fumes obtained from the decomposition of sodium nitrate, which changes SO_2 into sulfur trioxide, SO_3 , and this uniting with steam yields sulfuric acid H_2SO_4 . If the sulfur were burned by itself, the product would be sulfur dioxide, which contains only two-thirds as much oxygen as sulfur trioxide. The object of the sodium nitrate is to furnish, by its decomposition, the requisite additional quantity of oxygen.

Sulfuric acid is now made on a large scale by what is termed the "contact method," in which a purified mixture of air and sulfur dioxide, from burning sulfur, is cooled to a temperature between 380° and 450° C. and then caused to pass over what is termed a catalytic agent, resulting in the extraction of oxygen from the air and the production of SO_3 , which in turn is dissolved in water or, for complete absorption, in concentrated sulfuric acid. As much as 99 per cent of the theoretical yield of sulfuric acid is thus obtained. Various substances have been used as the catalytic agents, which are themselves not altered during the reaction. Platinized asbestos, finely subdivided platinum distributed over a magnesium salt, vanadium pentoxide, and the sulfates of thorium, cerium, and praseodymium have all been employed. This process is more easily operated than the "lead chamber process" and the pure acid can be produced at less cost,

Description and Physical Properties -- A colorless, odorless liquid of oily consistence, very caustic and corrosive. Sulfuric Acid is miscible with water and with alcohol, in either case with the evolution of much heat. When strongly heated, the Acid is vaporized with the evolution of dense, white fumes.

Tests for Identity -- Sulfuric Acid is strongly acid to litmus paper even when highly diluted. It responds to the tests for sulfate. Sulfuric acid with or without the aid of heat chars sucrose, wood, and many other organic substances.

USP Preparations -- Acidum Sulfuricum Aromaticum; Acidum Sulfuricum Dilutum.

NF Preparations -- Liquor Ferri Subsulfatis; Oleum Aethereum.

History -- The sulfates were originally termed vitriols. Green vitriol or vitriol of Mars contained iron; blue vitriol or vitriol of Venus contained copper, and white vitriol was known to be in some way connected with calamine. Albertus Magnus in the thirteenth century first used these terms and found that when a vitriol was subjected to a high temperature in a retort an oily liquid distilled over which was called oil of vitriol.

Sulfuric acid is generally known by the old name of oil of vitriol. A commercial variety of sulfuric acid, which contains an extra molecule of SO_3 and which is sometimes given the formula $\text{H}_2\text{S}_2\text{O}_7$, is known sometimes by the name of Nordhausen Sulfuric Acid, and in some of the industries is referred to by the dangerously misleading name of oleum.

Storage -- Preserve Sulfuric Acid in glass-stoppered bottles.

Uses -- Sulfuric acid is the most powerful of the official inorganic acids. It is employed in making many preparations, mostly on account of its energetic action in decomposing salts, and the large use made of its compounds with metals, alkaloids, and other bodies. It is rarely used in the pure state as an escharotic, owing to its tendency to spread. When accidentally dropped upon the skin, a quick and profuse application of magnesia will prove effective. Unless the quantity of acid is very small, care should be used in applying water, except when a very large quantity can be applied at once, as the amount of heat produced when water is mixed with sulfuric acid increases the pain. Internally, sulfuric acid is administered either in its diluted form or as aromatic sulfuric acid.

ACIDUM SULFURICUM AROMATICUM USP Aromatic Sulfuric Acid
(Acid. Sulfuric. Arom.)

Aromatic Sulfuric Acid contains in each 100 cc., free sulfuric acid and ethylsulfuric acid together equivalent to not less than 19 Gm. and not more than 21 Gm. of H_2SO_4 .

Sulfuric Acid.	114 cc.
Fluidextract of Ginger.	10 cc.
Oil of Cinnamon.	1 cc.
Alcohol, a sufficient quantity,	
To make.	1000 cc.

Add the sulfuric acid gradually, and with great caution, to 700 cc. of alcohol, and allow the mixture to cool. Then mix with it the fluidextract of ginger and the oil of cinnamon, and add enough alcohol to the product to measure 1000 cc.

If the acid-alcohol mixture is not cooled, as directed, before adding the oil and fluidextract, the finished product will be much darker in color than normally, due to greater caramelization at elevated temperatures.

Description and Physical Properties -- A clear, reddish brown liquid having a pleasant, aromatic odor.

Alcohol Content -- From 80 to 85 per cent, by volume, of C_2H_5OH .

Storage -- Preserve Aromatic Sulfuric Acid in glass-stoppered bottles.

Uses -- This preparation, known as elixir of vitriol, is employed principally as a remedy for diarrhea. It is used sometimes as an excipient for quinine pills, to reduce their size and render them more soluble. The dose is 0.5 cc.

ACIDUM SULFURICUM DILUTUM USP Diluted Sulfuric Acid
(Acid. Sulfuric. Dil.)

Diluted Sulfuric Acid is an aqueous solution containing, in each 100 cc., not less than 9.5 Gm. and not more than 10.5 Gm. of H_2SO_4 .

Diluted Sulfuric Acid may be prepared as follows:

Sulfuric Acid.	57 cc.
Distilled water, a sufficient quantity,	
To make.	1000 cc.

Pour the acid gradually, with constant stirring, into 900 cc. of distilled water, and allow the solution to cool. Add sufficient distilled water to make 1000 cc.

The strong acid is added gradually to the water, to guard against the too sudden production of heat, which might cause the fracture of a glass vessel. If "lead chamber" sulfuric acid which has not been purified by redistillation is diluted with water, the liquid becomes slightly turbid, and in the course of a few days deposits a grayish-white powder, which is lead sulfate. Sulfuric acid prepared by the "contact method" will not show this precipitate.

Description and Physical Properties -- A colorless, odorless liquid having a strongly acid taste.

Storage -- Preserve Diluted Sulfuric Acid in glass-stoppered bottles.

Uses -- Diluted sulfuric acid has the same properties as the acid from which it is made, except those which are dependent upon the strength of the latter. It is given internally in gastric and intestinal disorders, properly diluted, doses of 1 cc.

ACIDUM ACETICUM DILUTUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Definition:

Prepare 120 cc. Show Calculations:

Formula:

Why should bottles containing acetic acid not be stoppered with rubber?

What change has been made in the methods of preparing diluted acids?

Why was this change made?

State the percentage strength of Glacial Acetic, Diluted Acetic, and Acetic Acids.

What official preparation is made using this acid?

State the uses and doses.

Physical Properties (color, odor, taste, etc.)

ACIDUM HYDROCHLORICUM DILUTUM

O. E. T. U.S.P. or N.F.

Syn. Abbr.

Definition:

Prepare 120 cc.

Show Calculation:

Formula:

Why is Commercial HCL colored?

Why does concentrated Hcl give rise to white fumes when exposed to air?

State the strength of Acid Hydrochloric.

How may Hydrochloric Acid be made?

Give the uses and doses of diluted acid.

Storage.

Physical Properties.

ACIDUM SULFURICUM AROMATICUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

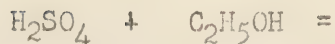
Definition:

Prepare 60 cc.

Show calculations:

Formula:

Description and physical properties.



Why does this preparation gradually become darker?

State the uses and doses.

Why does the addition of water to this acid cause a ppt?

Storage.

Physical Properties.

ACIDUM SULFURICUM DILUTUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Definition:

Prepare 120 cc.

Show calculations:

Formula:

Why should sulfuric acid be poured into water and not water into the acid in mixing the two?

Why does sulfuric acid when dropped on wood or like organic matter blacken it?

Why is lead so often an impurity in sulfuric acid?

SOLUTIONS

Most of the preparations classed by the Pharmacopoeia under this head are solutions of non-volatile substances in water. Exceptions to this definition are found in the solutions of compound cresol, formaldehyde, compound iodine; chlorinated soda, and surgical solution of chlorinated soda, because they contain volatile active ingredients, though they also contain some non-volatile matter. Solution of Irradiated Ergosterol is an oily solution. The definition of solutions as "aqueous solutions of non-volatile bodies" is redundant, inasmuch as we say that a "solution" (the class of pharmaceuticals) is a "solution" (that is, a product of the physical phenomenon called solution, which has been discussed under the section of Galenical Pharmacy. In other words, the student at the outset should get a clear idea of the three meanings of the word "solution". First, the physical phenomenon of molecular subdivision resulting in a homogeneous fluid; second, the physical group of solutions, those homogeneous fluids produced by molecular subdivision, and including such pharmaceuticals as waters, spirits, glycerites, tinctures, etc; and third, the narrow pharmaceutic "solution" which includes only that class of physical solutions which have water as the solvent and a non-volatile body as dissolved substance. A simple solution is one in which the active ingredient or ingredients are added directly to the solvent. A chemical solution is one in which the active ingredient is formed in the process of manufacture, as the result of chemical action.

LIQUOR ACIDI ARSENIOSI USP Solution of Arsenous Acid
(Liq. Acid. Arsen.--Hydrochloric Solution of Arsenic; Solution of Arsenic Chloride)

Solution of Arsenous Acid contains, in each 100 cc., the equivalent of not less than 0.975 Gm. and not more than 1.025 Gm. of As_2O_3 .

Arsenic Trioxide.	10 Gm.
Diluted Hydrochloric Acid.	50 cc.
Distilled Water, a sufficient quantity,	
To Make.	1000 cc.

Mix the diluted hydrochloric acid with 250 cc. of distilled water in a flask, add the arsenic trioxide, and boil the liquid until the arsenic trioxide is completely dissolved. Allow the solution to cool, transfer it to a 1000 cc. graduated flask or cylinder, rinse the vessel in which the solution was boiled, with several portions of distilled water, and add the rinsings and enough distilled water to make the product measure 1000 cc. Filter if necessary.

This is simply a solution of arsenous acid in diluted hydrochloric acid, no chemical action taking place. Water is added occasionally as the boiling must be continued for some time, the trioxide repelling water and floating on top.

Description and Physical Properties -- A clear, colorless liquid without odor. Solution of Arsenous Acid is acid to litmus paper.

Uses -- Solution of arsenous acid is used as an alterative, in doses of 0.2 cc.

LIQUOR CALCII HYDROXIDI USP Solution of Calcium Hydroxide.
(Liq. Calc. Hydrox. -- Liquor Calcis; Lime Water)

Solution of Calcium Hydroxide is an aqueous solution containing in each 100 cc., at 25° C., not less than 0.14 Gm. of $\text{Ca}(\text{OH})_2$. The content of calcium hydroxide varies with the temperature at which the solution is stored, being about 0.17 Gm. per 100 cc. at 15° C., and less at a higher temperature.

Solution of Calcium Hydroxide may be prepared as follows:
Calcium Hydroxide. 3 Gm.
Distilled Water, a sufficient quantity,

Add 3 Gm. of calcium hydroxide to 1000 cc. of cool distilled water, and agitate the mixture vigorously and repeatedly during one hour. Allow the excess of calcium hydroxide to settle. Decant and dispense only the clear, supernatant liquid.

The undissolved portion of the mixture is not suitable for preparing additional quantities of Solution of Calcium Hydroxide.

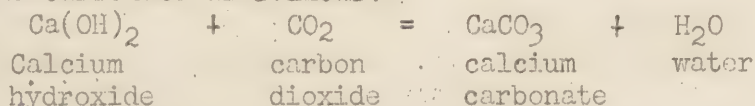
Lime water is very extensively used in pharmacy; the object of keeping it upon undissolved lime is to insure a saturated solution. Lime is but sparingly soluble in water and less soluble in hot water than in cold; when the solution is heated, a deposition of lime takes place and is redissolved on cooling. A solution of lime containing particles of undissolved lime in suspension is termed milk of lime.

Description and Physical Properties -- A clear, colorless, odorless liquid with a sweetish, alkaline taste.

NF Preparations -- Linimentum Calcis; Linimentum Calaminae; Lotio Calaminae; Lotio Flava; Lotio Nigra; Pasta Zinci Oxidi Mollis.

Storage -- Preserve Solution of Calcium Hydroxide in well-filled, tightly-stoppered bottles, in a cool place.

When lime water is exposed to air, which almost always contains CO_2 , the calcium hydroxide is quickly converted into the insoluble carbonate as follows:



To avoid such deterioration the lime water may be stored in a large bottle from which it may be drawn by means of a glass siphon. A piece of rubber tubing is attached to the outlet of the siphon and is opened or closed by a pinchcock to be used when the lime water is drawn from the container. This siphon is held in place by a rubber stopper which also carries an air tube leading to a small bottle of solution of sodium hydroxide. By this plan all air admitted to the bottle of lime water is first passed through the NaOH solution and deprived of CO_2 .

Uses -- Probably the most extensive use of lime water in

medicine is in checking nausea, although its value is greatly over-estimated; it contains so small a proportion of alkali that it would require upwards of a tumblerful to have any real effect. It is usually administered with milk when used for correcting its acidity, especially in infant feeding. It is employed externally to allay inflammation, and in washes of various kinds. The dose of lime water is 15 cc.

LIQUOR IODI COMPOSITUS USP Compound Solution of Iodine
(Liq. Iodi Co. -- Lugol's Solution)

Compound Solution of Iodine is a solution containing, in each 100 cc., not less than 4.5 Gm. and not more than 5.5 Gm. of I, and not less than 9.5 Gm. and not more than 10.5 Gm. of KI.

Iodine. 5 Gm.
Potassium Iodide. 10 Gm.
Distilled Water, a sufficient quantity,
To make. 100 cc.

Dissolve the iodine and potassium iodide in 10 cc. of distilled water, then add a sufficient quantity of distilled water to make the product measure 100 cc. The potassium iodide is added only to increase the solubility of the iodine.

Description and Physical Properties -- A transparent liquid having a deep brown color, and the odor of iodine.

NF Preparation -- Liquor Iodi Phenolatus.

Storage -- Preserve Compound Solution of Iodine in glass bottles, closed with stoppers resistant to corrosion, and in a cool place, protected from light.

Uses -- This solution, containing about 0.2 Gm. of iodine in each 4 cc., affords an efficient means of administering iodine internally. It is given in 0.2 cc. doses, and, to prevent gastric irritation, it must be largely diluted.

LIQUOR SODII CHLORIDI PHYSIOLOGICUS USP Physiological Solution of Sodium Chloride
(Liq. Sod. Chlor. Physio. -- Physiological Salt Solution, Normal Saline Solution)

Sodium Chloride. 8.5 Gm.
Distilled Water, freshly distilled, a sufficient quantity,
To make. 1000 cc.

Dissolve the sodium chloride in sufficient freshly distilled water, neutral to litmus paper, to measure 1000 cc., and filter, returning the filtrate until free from foreign particles. Transfer the solution to a sterile flask of insoluble glass, having a capacity of about 1000 cc., and stopper with a plug of purified non-absorbent cotton, wrapped in gauze. Fasten stout, non-absorbent paper or tinfoil over the top of the cotton and the lip of the container, and sterilize in a autoclave under steam pressure, maintaining a temperature of not less than 115° C. for thirty minutes.

Note -- This solution must be protected from contamination and should be used within twenty-four hours after its sterilization if not stored in hermetically-sealed containers.

If stored in hermetically sealed containers, it should conform to the tests for sterility, USP XI, Page 469.

In this preparation as in the USP sterilized distilled water, it is essential that "freshly distilled water" be used to eliminate the danger of pyrogenic contamination. The comments on sterility also apply to this important product.

This solution is generally accepted as isotonic with blood serum, although a true isotonic solution is more nearly represented by one containing approximately 9 Gm. of sodium chloride in each 1000 cc. of solution.

Physiological Salt Solution is extensively used. It is administered intravenously in large quantities following operations and on other occasions, to replace blood lost by hemorrhage. It frequently serves as a solvent in place of ampul water in preparing certain dilute solutions. Such solutions will thus be nearly isotonic in nature, the slight hypertonicity being preferable to what might otherwise be a hypotonic solution.

LIQUOR MAGNESII CITRATIS USP Solution of Magnesium Citrate
(Liq. Mag. Cit.)

Solution of Magnesium Citrate contains, in each 100 cc. an amount of magnesium citrate corresponding to not less than 1.6 Gm. and not more than 1.9 Gm. of MgO.

Magnesium Carbonate.	15 Gm.
Citric Acid.	33 Gm.
Syrup	60 cc.
Purified Talc.	5 Gm.
Oil of Lemon.	0.1 cc.
Potassium Bicarbonate.	2.5 Gm.
Distilled Water, a sufficient quantity,	
To make:	350 cc.

Dissolve the citric acid in 150 cc. of hot distilled water in a suitable dish, and having added the magnesium carbonate, previously mixed with 100 cc. of distilled water, stir until it is dissolved. Then add the syrup, heat the mixed liquids to the boiling point, immediately add the oil of lemon, previously triturated with the purified talc, and filter the mixture, while hot, into a strong bottle (previously rinsed with boiling distilled water) of suitable capacity. Add enough boiled distilled water to make the product measure 350 cc. Stopper the bottle with purified cotton, allow to cool, drop in the potassium bicarbonate and immediately stopper the bottle securely. Lastly, shake the solution occasionally until the potassium bicarbonate is dissolved. Keep the bottle on its side in a cool place, preferably in a refrigerator.

Note -- In this process the 2.5 Gm. of potassium bicarbonate may be replaced by 2.1 Gm. of sodium bicarbonate, preferably in tablet form and, in addition, the solution may be carbonated by the use of CO₂, under pressure.

The stability of Solution of Magnesium Citrate is improved by adjusting the quantity of magnesium carbonate for each 350 cc. of Solution so that it corresponds to 6.0 Gm. of MgO and by sterilizing the Solution after it has been bottled.

Description and Physical Properties. -- A slightly yellow, clear, effervescent liquid, having a sweet, acidulous taste and a lemon flavor.

If the official Solution is too acid for the patient, an additional amount of sugar or syrup will render it more palatable. The use of distilled water has been found necessary, as precipitation has frequently been traced to the use of ordinary water. The USP process attempts by the use of heat to eliminate mold spores or other microorganisms which are likely to be present in the solution and cause confervoid growths. If the pharmacy technician experiences annoyance and loss from this cause, it may be overcome even more effectually by preparing the solution without any attempt at sterilization, then bottling, closing the bottles with absorbent cotton, and afterward sterilizing them by heating in a closed vessel containing boiling water.

Uses -- Citrate of magnesia or "citrate", as it is usually called, is one of the most agreeable saline cathartics available. It is usually given to adults in the quantity of the official formula, 350 cc., although the USP XI changed the average dose to 200 cc. which is more in harmony with the frequent practice of administering one-half of the contents of the regular 12 ounce bottle.

LIQUOR ANTISEPTICUS NF Antiseptic Solution
(Liq. Antisept.)

Boric Acid.	25 Gm.
Thymol.	1 Gm.
Chlorthymol.	1 Gm.
Menthol.	1 Gm.
Eucalyptol.	2 cc.
Methyl Salicylate.	1.2 cc.
Oil of Thyme.	0.2 cc.
Alcohol,	

Distilled Water, each, a sufficient quantity,
To make. 1000 cc.

Dissolve the boric acid in 650 cc. of distilled water and the other ingredients in 250 cc. of alcohol. Mix the two solutions and allow the mixture to stand in a warm place, with occasional agitation, during twenty-four hours; then filter, using 10 Gm. of purified talc, if necessary, to clarify the product; add 50 cc. of alcohol to the filtrate and sufficient distilled water to make the product measure 1000 cc.

Note: The final addition of alcohol is for the purpose of increasing the alcoholic per cent of the finished product. The filtrate, before this addition, is saturated, and if the alcohol per cent were not increased, the solution, if cooled below the temperature at which it was filtered, would precipitate or become cloudy, due chiefly to the separation of thymol.

Description and Physical Properties -- NF Antiseptic Solution is a clear, colorless liquid having an aromatic odor and a characteristic taste.

Alcohol content -- From 26 to 29 per cent, by volume, of C_2H_5OH .

Uses -- This is used chiefly as a mouth wash and for halitosis and to insure germicidal action it must be used undiluted. Chlorothymol has been added to the formula to increase its antiseptic and germicidal efficiency.

LIQUOR AROMATICUS ALKALINUS NF Alkaline Aromatic Solution (Liq. Aromat. Alk. -- Liquor Antisepticus Alkalinus, NF IV; Alkaline Antiseptic Solution)

Potassium Bicarbonate.	20 Gm.
Sodium Borate.	20 Gm.
Thymol.	0.5 Gm.
Eucalyptol.	1 cc.
Methyl Salicylate.	0.5 cc.
Tincture of Cudbear.	20 cc.
Alcohol.	50 cc.
Glycerin.	100 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Mix the potassium bicarbonate and sodium borate with 100 cc. of distilled water, and add the glycerin; when the effervescence has ceased, add the mixture to 500 cc. of distilled water. Dissolve the thymol, eucalyptol, methyl salicylate, and tincture of cudbear in the alcohol; then add the solution of the salts to the alcoholic solution, with constant agitation; finally add sufficient distilled water to make the product measure 1000 cc. Allow the mixture to stand, with occasional shaking, for twenty-four hours; then filter, using 10 Gm. of purified talc, if necessary, to clarify the product.

Description and Physical Properties -- Alkaline Aromatic Solution is a clear, bright red liquid, with an aromatic odor and taste.

Alcohol content - From 4 to 7 per cent, by volume, of C_2H_5OH .

Uses -- The name of this solution has been changed. It was formerly known as Alkaline Antiseptic Solution but this was inappropriate. Its chief value lies in the fact that it is approximately isotonic with the body fluids and is, therefore, not irritant to mucous membranes. The Alkaline Aromatic Solution is extensively used as a nasal douche and throat gargle. Use undiluted for oral treatment or when used in a dental spray bottle, dilute with 5 volumes of water.

The effervescence noted is due to a reaction between borax, glycerin, and water, forming boric acid, which liberates carbon

dioxide from potassium bicarbonate. (See Compound Solution of Sodium Borate).

LIQUOR AMMONII ACETATIS. USP Solution of Ammonium Acetate (Liq. Ammon. Acet. -- Spirit of Mindererus)

Solution of Ammonium Acetate contains, in each 100 cc. not less than 6.5 Gm. and not more than 7.5 Gm. of $\text{CH}_3\text{COO.NH}_4$, with small amounts of acetic and carbonic acids.

Caution -- Only a recently prepared Solution of Ammonium Acetate should be dispensed.

Ammonium Carbonate, in hard, translucent pieces. 5 Gm.
Diluted Acetic Acid. 100 cc.

Dissolve the ammonium carbonate in the diluted acetic acid without strong agitation.

Solution of Ammonium Acetate may also be prepared as follows:

Solution No. 1

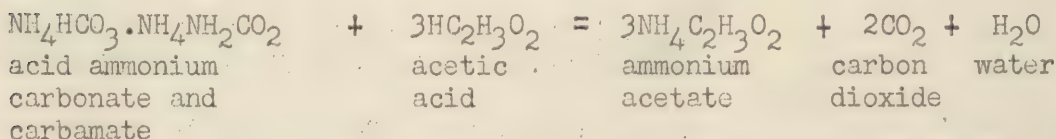
Ammonium Carbonate, in hard, translucent pieces. 50 Gm.
Distilled Water, a sufficient quantity,
To make. 500 cc.

Solution No. 2

Acetic Acid. 160 cc.
Distilled Water, a sufficient quantity,
To make. 500 cc.

Cautiously mix the two solutions in equal volumes in a capacious vessel, in quantities sufficient to produce the amount of Solution of Ammonium Acetate needed.

The reaction involved in this process depends upon the decomposition of the ammonium carbonate with acetic acid; the free carbonic acid is a desirable addition to the solution, which should be dispensed in a slightly effervescent condition.



It will be found in practice that the second formula is much more satisfactory than the first. The separate solutions keep well, and it is very convenient to mix them at the time of dispensing, and thus always be enabled to send out a fresh preparation, which retains sufficient carbonic acid to be agreeable to the patient.

Hard, translucent masses of ammonium carbonate should be used because they are more constant in composition than those which have some pulverulent powder. Official ammonium carbonate is a mixture of ammonium bicarbonate and ammonium carbamate, and on exposure loses ammonia and carbon dioxide, leaving ammonium bicarbon-

ate. It should not be bottled before reaction is complete as the generated CO_2 may produce enough pressure to break the bottle. On long keeping it may become alkaline.

Description and Physical Properties -- A clear, colorless liquid, free from empyreumatic odor. It has a mildly saline, acidulous taste and an acid reaction to litmus paper.

Uses -- This solution is used as a diaphoretic and diuretic, in the dose of 15 cc.

LIQUOR POTASSII CITRATIS NF Solution of Potassium Citrate
(Liq. Pot. Cit.)

Solution of Potassium Citrate is an aqueous solution containing, in each 100 cc. not less than 8 Gm. of $\text{K}_3\text{C}_6\text{H}_5\text{O}_7$, with small amounts of free citric and carbonic acids.

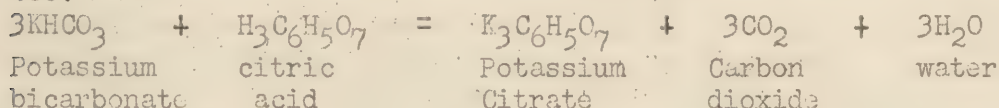
Potassium Bicarbonate. 8 Gm.
Citric Acid. 6 Gm.
Distilled Water, a sufficient quantity,

To make. 100 cc.

Dissolve the potassium bicarbonate and the citric acid, each in 40 cc. of distilled water. Filter the solutions separately and wash the filters with enough distilled water to obtain, in each case, 50 cc. Mix the two solutions; when effervescence has ceased, transfer to a bottle and stopper tightly.

Note -- This preparation must not be dispensed unless it has been recently prepared, as the carbon dioxide in it makes it pleasanter to take, and a fungous growth is likely to form on standing. Lemon juice was formerly used in place of citric acid, and this was known as "neutral mixture". A slight excess of acid is used to give an acidulous taste. As soon as effervescence has ceased, it is put into tightly stoppered bottles to keep the solution saturated with carbon dioxide.

The following equation represents the major reaction although there is also some potassium acid citrate probably formed too.



Description and Physical Properties -- Solution of Potassium Citrate is a clear, colorless, odorless liquid, with a slightly acidulous, saline taste.

Uses -- Solution of potassium citrate is diuretic and diaphoretic, in doses of 15 cc.

LIQUOR POTASSII IODIDI NF Solution of Potassium Iodide
(Liq. Pot. Iod. -- Saturated Solution of Potassium Iodide)

Solution of Potassium Iodide is an aqueous solution containing, in each 100 cc., not less than 97 Gm. and not more than 103 Gm. of KI.

Potassium Iodide. 100 Gm.
 Distilled Water, a sufficient quantity,
 To make. 100 cc.
 Dissolve the salt in 68 cc. of hot distilled water; cool to about 25° C., and add sufficient distilled water to make 100 cc. filter, if necessary.

Note -- If the solution is not to be used extemporaneously 0.05 Gm. of sodium thiosulfate should be added.

A solution of potassium iodide slowly becomes colored, due to the liberation of iodine. Sodium thiosulfate, which is a reducing agent, is put in to prevent the liberation of iodine and discoloration of the solution. Potassium iodide is generally made slightly alkaline, because in that condition it does not discolor so quickly. One hundred grams of potassium iodide, when dissolved in water, increase the volume approximately 25 cc.

Description and Physical Properties -- Solution of Potassium Iodide is clear, colorless and odorless, with a characteristic, strongly saline taste.

Storage -- Keep the solution in well-stoppered, amber-colored bottles.

Uses -- This is a valuable alterative, useful in a host of chronic diseases including goiter, syphilis, rheumatism, arteriosclerosis, etc. It is used as an alterative in 0.3 cc. doses.

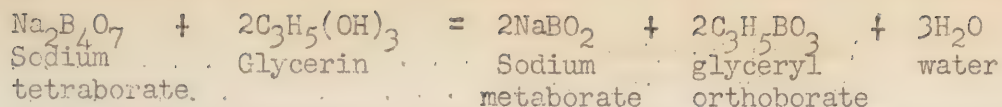
LIQUOR SODII BORATIS COMPOSITUS NF Compound Solution of
 Sodium Borate
 (Liq. Sod. Bor. Co. -- Dobell's Solution)

Sodium Borate. 15 Gm.
 Sodium Bicarbonate. 15 Gm.
 Liquefied Phenol. 3 cc.
 Glycerin. 35 cc.
 Water, a sufficient quantity,

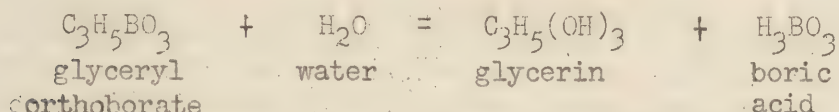
To make. 1000 cc.
 Dissolve the sodium borate and sodium bicarbonate in about 500 cc. of water, add the glycerin and liquefied phenol, and allow the mixture to stand half an hour or until the effervescence has ceased; then add sufficient water to make the product measure 1000 cc., and filter.

Description and Physical Properties -- Compound Solution of Sodium Borate is a clear yellowish liquid, with a phenol-like odor.

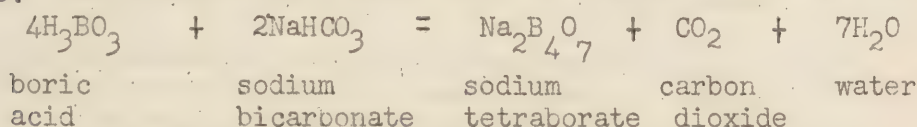
When prepared as directed an effervescence always occurs, due to the decomposition of sodium borate by the glycerin to form an acid which reacts with sodium bicarbonate. The exact nature of the reaction is not known definitely. One theory is that sodium borate reacts with the glycerin to form glyceryl borate and sodium metaborate, as follows.



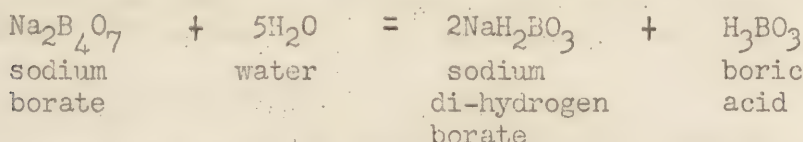
The glyceryl or the borate promptly undergoes hydrolysis with the liberation of free boric acid, according to the equation:



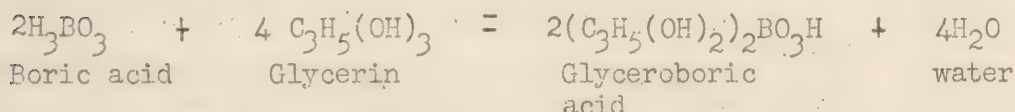
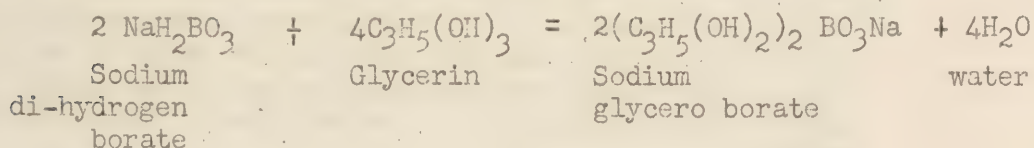
The boric acid attacks the bicarbonate of soda in the usual manner, liberating carbon dioxide, which causes the effervescence:



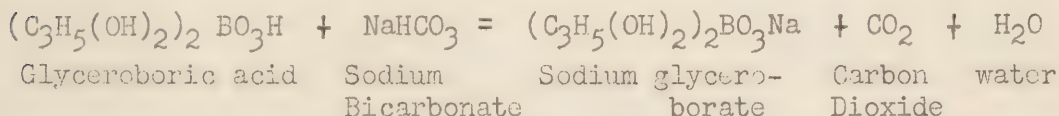
Another explanation, offered by other authorities, assumes the preliminary hydrolysis of sodium borate as follows:



The products of this reaction then react with glycerin according to the following equations



Finally, the glyceroboric acid, which is a stronger acid than boric acid and therefore might be expected to take part in such a reaction, reacts with sodium bicarbonate as follows:



Uses -- This solution is used as an alkaline, mildly antiseptic nasal wash or spray. For use on mucous membranes: Undiluted; or, for the dental spray bottle, dilute with 5 volumes of water.

LIQUOR POTASSII ARSENITIS USP Solution of Potassium Arsenite (Liq. Pot. Arsen. - Fowler's Solution; Solutio Arsenicalis seu Fowleri, PI)

Solution of Potassium Arsenite contains, in each 100 cc., the equivalent of not less than 0.950 Gm. and not more than 1.050 Gm. of As_2O_3 .

Arsenic Trioxide.	10 Gm.
Potassium Bicarbonate.	7.6 Gm.
Alcohol.	30 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Boil the potassium bicarbonate and arsenic trioxide in a flask with 100 cc. of distilled water until solution is effected. Cool the solution, and transfer it to 1000 cc. graduated container, rinsing the flask in which the liquid was boiled with several portions of distilled water to make a solution measuring 950 cc. Add the alcohol and sufficient distilled water to make the solution measure 1000 cc. Mix thoroughly, and filter.

When arsenic trioxide is boiled with acid potassium carbonate in concentrated solution, carbon dioxide is evolved, and a potassium metarsenate, over the exact formula of which there has been considerable controversy, is produced. Alcohol was added to the solution to preserve it. It is advised that this solution should not be kept longer than a year, as it is slowly oxidized to the arsenic condition which is less active therapeutically.

Description and Physical Properties -- A clear, colorless liquid, alkaline to litmus paper.

History -- This preparation was given publicity by Thomas Fowler, M. D., an English physician of the latter part of the eighteenth century. He based it upon a proprietary preparation called "tasteless ague and fever drops" which he analyzed with the aid of a local pharmacist named Hughes. He proposed for it the name of Liquor Mineralis to conceal the presence of arsenic from the patient.

Alcohol content - From 1 to 3 per cent by volume, of C_2H_5OH .

Uses - Solution of potassium arsenite is largely used as an alterative and tonic in doses of 0.2 cc.

O. E. T.

Definition:

In general, how do solutions differ from aromatic waters?

Into what three groupings are solutions classified?

What type of solutions are ammonia and formaldehyde?

LIQUOR ACIDI ARSENOSI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 120 cc.

Show calculations:

Formula:

Use and Dose.

Description and Physical Properties:

LIQUOR CALCII HYDROXIDI

O.E.T. : U.S.P. or N.F.

Syn. : Abbr.

Requirement:

Prepare 480 cc.

Show calculations:

Formula:

Give chemical equation involved in preparation:

What affect does climatic conditions have on this preparation.

Show by chemical equation the action of CO_2 on this preparation.

What is "Milk of Lime"?

Use and dose.

Should the bottle be shaken before dispensing?

LIQUOR AROMATICUS ALKALINUS.

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc.

Formula:

Show calculations:

Use:

Description and Physical Properties:

LIQUOR IODI COMPOSITUS.

O.E.T.

.Syn.

Requirement:

Prepare 60 cc.

Show calculations:

Formula:

Why is so much more KI used in this preparation than in the Tincture of Iodine?

Use and dose.

LIQUOR SODII CHLORIDI PHYSIOLOGICUS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Definition:

Prepare 240 cc.

Show Calculations:

Formula:

Why should physiological salt solution be sterilized?

How soon should this solution be used after sterilization?

State uses and doses.

LIQUOR MAGNESII CITRATIS

O.E.T. : U.S.P. or N.F.

Abbr.

Requirement:

Prepare 350 cc.

Formula:

Show by chemical equation the reaction involved.

How may the stability of this solution be improved?

Why is the solution bottled and stoppered with cotton while cooling?

Why should bottles of this solution be kept on their side and in a cool place?

Use and Dose.

LIQUOR ANTISEPTICUS N. F. V.

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 240 cc. Show Calculations:

Formula:

Why was a portion of the alcohol reserved and added to the filtrate?

Uses:

Storage:

Description and Physical Properties:

Why should the aqueous solution of boric acid be added to the alcoholic solution?

LIQUOR AMMONII ACETATIS

O.E.T. U.S.P. or N.F.

Syn:

Requirement:

Prepare 120 cc.

Formula:

Give chemical equation involved:

Caution:

Compare the merits of the two formulas given in the U.S.P.

Use and Dose:

Description and Physical Properties:

LIQUOR POTASSII CITRATIS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Definition:

Prepare 120 cc.

Show calculations:

Formula:

Give description and physical properties.

Show formula for reaction that takes place.

Why should solution of potassium citrate be made first?

State uses and doses.

LIQUOR POTASSII IODIDI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Definition:

Prepare 30 cc.

Show Calculations:

Formula:

Why is Sodium Thiosulfate used in making solution of potassium iodide?

What per cent increase in volume is caused by potassium iodide when dissolved in water?

State uses and doses.

LIQUOR SODII BORATIS COMPOSITUS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc.

Show Calculations.

Formula:

Give the general theory as to the chemical reaction which takes place in this preparation?

Why are the salts dissolved in only one-half of the distilled water?

Explain the effervescence following mixing.

Uses.

Storage.

Description and physical properties.

LIQUOR POTASSII ARSENITIS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 120 cc.

Show Calculations.

Formula:

Why are the potassium carbonate and arsenic trioxide boiled with only 10% of the total amount of water?

Show by equations the reactions involved.

Uses and doses.

Storage.

Description and physical properties.

Under what provision was this solution placed in the U.S.P. XI?

SYRUPS

1. a. DEFINITION -- SYRUPS are concentrated solutions of sucrose in water or aqueous liquids. "Sucrose" is the chemical name now used officially by the Pharmacopoeia and by the National Formulary for the substance known in every household as sugar. Syrups sometimes contain acetic acid or other organic acids; and occasionally a small quantity of alcohol. When distilled water alone is used in making the solution of sucrose, the preparation is termed syrup, or simple syrup. When the solution contains soluble principles from various medicinal substances, the syrup is called a medicated syrup. A flavored syrup is one which is not medicinal in its action, but which contains various aromatic or pleasantly flavored substances. Syrups are useful preparations, because their sweet taste facilitates administration; and being practically saturated solutions of sucrose they do not ferment. The sucrose must be carefully selected and cleanliness must be observed if syrups are to be permanent preparations.

b. Selection of the Sucrose or Sugar. -- The quality of sucrose which should be used in making syrups is clearly defined by the Pharmacopoeia. It is described as "colorless or white crystals, crystalline masses or blocks, or a white, crystalline powder." It is to be odorless, have a sweet taste, and be stable in the air. The white crystalline variety, known commercially as granulated sugar is most frequently used in making syrup. Sucrose must be free from ultramarine, Prussian blue, and insoluble substances, as the presence of impurities, particularly ultramarine, has been shown to interfere with the stability and quality of syrups. The blue dyes mentioned were formerly used to cover the yellow tint of sugar improperly purified, but today the processes and quality of sugar or sucrose have been so improved that the dyes are rarely employed. Sucrose for use in syrups should be sensibly dry because the permanency of syrups largely depends upon their containing the correct proportion of sucrose and water. If an insufficient amount of sucrose is present, the syrups will ferment; if they contain too much, crystallization of the excess takes place at first, while the subsequent growth of the crystals is accompanied by an abstraction of sucrose from the liquid, and the result is such a weakening of the syrup that fermentation may result, as in the first instance. Damp sugar should never be used unless the amount of moisture has been carefully ascertained, and an allowance made for it. Commercial sugars of exceptional purity and whiteness are now offered under such names as "Druggists Standard," "Special Standard Granulated," "Confectioners Granulated," etc. The crystals are unusually large and perfect and are dry, with less tendency to become moist from atmospheric dampness than other sugars. They represent the crystallization from the first running of the filters in the sugar refinery, corresponding to the old "rock candy", and consequently produce a superior syrup, almost entirely free from yellowish tint, even when observed in large volume. Such syrup is frequently called Rock Candy Syrup.

c. Preparation of Syrups -- Syrups are prepared in various ways, and the choice of the proper method must always depend upon the physical and chemical characteristics of the substances entering into the preparation. Five methods are officially recognized, which may be summarized as follows; 1. By solution with heat. 2. By agitation without heat. 3. By the simple addition of a medicating liquid to syrup. 4. By digestion or maceration. 5. By percolation.

(1) By Solution with Heat -- This is the usual method of making syrups when the valuable constituent is neither volatile nor injured by heat, and when it is desirable to make the syrup rapidly. The sucrose is usually added to the distilled water or aqueous solution and heated until solution is effected, then skimmed or strained, and sufficient distilled water added to make the desired weight or measure. If the syrup is made from an infusion, a decoction, or an aqueous solution containing organic matter, it is usually proper to heat the syrup to the boiling point to coagulate albuminous matter; this is separated subsequently by straining. If the albumin or other impurities were permitted to remain in the syrup, fermentation would probably be induced in warm weather. Excessive heating of syrups at the boiling temperature is undesirable since more or less inversion of the sucrose occurs with an increased tendency to ferment. Syrups cannot be sterilized in an autoclave without some caramelization. This is indicated by a yellowish or brownish color showing the presence of caramel, produced by the high temperature acting upon sucrose.

(2) By Agitation without Heat -- This process is directed by the Pharmacopoeia in those cases where heat would cause the loss of valuable volatile constituents. The sucrose should be added to the aqueous solution in a bottle of twice the size required for the syrup. This permits active agitation and rapid solution. A "five pint," glass stoppered bottle is well adapted for making of 1000 cc. of syrup by this process. The stoppering of the bottle is important as it prevents contamination and loss during the process. The bottle should be allowed to lie upon its side when not being agitated.

(3) By the Simple Addition of a Medicating Liquid to Syrup -- This method is resorted to in those cases in which fluid-extracts, tinctures, or other liquids are added to syrup to medicate it. Syrups made in this way usually develop precipitates since alcohol enters into most of the liquids thus used, and the resinous and oily substances dissolved by alcohol precipitate when mixed with the syrup, producing unsightly preparations. A modification of this process, frequently adopted, consists of mixing the fluid-extract or tincture with water, allowing the mixture to stand to permit the separation of insoluble constituents, filtering, and then dissolving the sucrose in the filtrate. This procedure is sometimes resorted to by manufacturing pharmacists to insure permanency in their products, but it is not permissible when the precipitated ingredients are the valuable medicinal agents. In such cases the syrup must be dispensed with the precipitate and a "shake label," or

some other form of medication adopted.

(4) By Maceration or Digestion -- This method is not recommended as either accurate or efficient. A solution of comparatively insoluble substance can always be effected in a more rapid and thorough manner by dissolving the substance in alcohol, suspending the resinous tincture in a mixture of absorbent powder (especially magnesium carbonate) and water, filtering, and dissolving sugar in the filtrate, as in the U.S.P. process for syrup of tolu.

(5) Percolation in Making Syrups -- This method originated with Orynski, and is conducted as follows: Into the lower orifice of an ordinary percolator introduce a small piece of sponge or purified cotton; the sucrose (granulated) is then poured in, and upon this is poured the distilled water, the apparatus being arranged as is usual in the process of percolation. The percolator may be covered loosely, and the operation will proceed without further attention, the syrup coming through drop by drop. If, after the liquid has all passed, there remains a quantity of undissolved sucrose in the percolator, enough percolate may be poured back to dissolve it, afterwards adding sufficient distilled water to secure the required quantity.

(a) To be successful in using this process care in several particulars must be exercised: 1. The percolator used should be cylindrical or semi-cylindrical, and cone-shaped as it nears the lower orifice. 2. The sugar must be coarse, else it will form into a compact mass, which the liquid cannot permeate. 3. The sponge or purified cotton must be introduced with care. If pressed in too tightly, it will effectually stop the process; if inserted too loosely, the liquid will pass too rapidly, and will, in consequence, be weak and turbid (from imperfect filtration); it should be inserted completely within the neck of the percolator, as a protruding end, inside the percolator, up through the sucrose, will permit the last portions of water to pass out at the lower orifice without dissolving all of the sucrose.

d. Preservation of Syrups -- (1) Syrups should not be made in larger quantities than can be used within a few months, except in those cases where special facilities can be employed for their preservation. A low temperature is the best method of preservation for syrups; concentration without supersaturation is also a condition favorable to preservation. The addition of such substances as benzoates, boric acid, salicylic acid, alcohol, fluorides, calcium sulfite, etc., to prevent the fermentation of syrups, is not recommended, for if used in sufficient quantity to act as preservatives they communicate their own flavor to the syrup or are otherwise objectionable and they are usually illegal. The practice of restoring syrups which have been spoiled through fermentation by heating them and "working them over" is reprehensible. The practice of good pharmacy demands the possession of sufficient moral courage to find a place for fermented syrups where they will do the least harm - i.e., in the sink and sewer-pipe.

(2) A simple and yet effective method of preserving syrups, especially adapted to fruit syrups, is as follows: A number of bottles are provided holding not more than a pint each, even when the quantity of syrup is large; the bottles are thoroughly cleaned, and kept hot by immersion in boiling water until ready for use; a sufficient number of good corks, which have been thoroughly soaked in hot, distilled water, and of the proper size for the bottles, should be at hand. The syrup should be heated to the boiling point (strained, if necessary, and reheated), and poured into the hot bottles until they are filled to the brim. The corks are inserted by forcibly pressing them into the necks of the bottles, thereby displacing a small portion of the syrup, and are tied down with twine in the usual manner. Then, while the necks of the bottles are still hot (and before the syrup can contract in volume through cooling) they are dipped into melted sealing-wax contained in a suitable vessel. By this method the organisms which produce fermentation are destroyed by the heat, and no air, carrying new contamination, can find its way to the syrup, as the bottles are hermetically sealed.

The official syrups should be preserved in well-dried bottles, preferably those which have been sterilized. These bottles should not hold more than is likely to be required during four to six weeks and should be completely filled, carefully stoppered, and stored in a cool, dark place.

SYRUPUS. U.S. SYRUP
(Sirup; Simple Sirup; Syrupus Simplex)

Sucrose.850 Gm.
Distilled Water, a sufficient quantity,	
To make.	<u>1000 cc.</u>

Insert into the neck of a percolator of suitable size a pledget of purified cotton, not too tightly, but in such a manner that the cotton shall nearly fill the neck of the percolator, and moisten it with a few drops of distilled water. Place the sucrose in the percolator, make its surface level without shaking or jarring, then carefully pour upon it 450 cc. of distilled water, and regulate the flow of the liquid, if necessary, so that it will pass out in rapid drops. Collect the percolate in a 1000 cc. graduated container and, if necessary, repass portions of it through the percolator until all of the sucrose has been dissolved. Then pass enough distilled water through the cotton to make the product measure 1000 cc. Mix thoroughly.

Syrup may also be prepared in the following manner:
Heat 450 cc. of distilled water to boiling, add the sucrose, and continue to heat it cautiously, stirring continuously, until the sucrose is dissolved and the syrup has a temperature of 100° C. Then filter it through purified cotton or other suitable filter and rinse the container with small portions of hot distilled water, passing the rinsings through the filter until the product measures 1000 cc. when cold. Mix thoroughly.

Syrup has been discussed in the general article on preceding pages, the quantity of the sugar, the amount of heat used, and the exact degree of concentration are all important factors in the production of a satisfactory syrup, as has already been stated.

Syrup properly prepared has a specific gravity of about 1.313 at 25° C.

U.S.P. and N.F. Preparations -- Elixirs, Emulsions, Liquors, Mixtures, Syrups, etc.

Storage -- Preserve Syrup in well-closed containers in a cool place.

Uses -- Employed as a sweetening agent, as an excipient in pills, and as the basis for many flavored and medicated syrups.

SYRUPUS BALSAMI TOLUTANI. U.S. Syrup of Tolu Balsam
(Syr. Balsam. Tolu.--Syrupus Tolu, U.S.P.X; Syrup of Tolu)

Tincture of Tolu Balsam.	50 cc.
Magnesium Carbonate.	10 Gm.
Sucrose.	820 Gm.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Mix the tincture intimately with the magnesium carbonate and 60 Gm. of sucrose in a mortar. Gradually add 430 cc. of distilled water with trituration, and filter. Dissolve the remainder of the sucrose in the clear filtrate with gentle heating, strain the syrup while warm, and add sufficient distilled water through the strainer to make the product measure 1000 cc. Mix thoroughly.

Syrup of Tolu Balsam may also be made in the following manner:

Prepare a percolator as described under Syrups, paragraph 1,c. Pour the filtrate obtained as directed in the formula above, upon the remainder of the sucrose contained in the percolator, and when all of the liquid has run through, return portions of the percolate, if necessary, until all of the sucrose has been dissolved. Then pass enough distilled water through the cotton to make the product measure 1000 cc. Mix thoroughly.

Magnesium carbonate is used in this syrup and in the syrup of ginger to aid the removal of finely precipitated matter caused by adding water to the alcoholic solutions.

Alcohol content -- From 2 to 4 per cent, by volume, of C_2H_5OH .

N.F. Preparation -- Mistura Pectoralis.

Uses -- Used chiefly for its agreeable flavor in cough syrups.

Average dose -- 10 cc.

SYRUPUS FERRI IODIDI. U.S. Syrup of Ferrous Iodide
(Syr. Ferr. Iod.--Syrupus Ferrosi Iodidi Concentratus, P.I.)

Syrup of Ferrous Iodide contains, in each 100 cc., not less than 6.5 Gm. and not more than 7.5 Gm. of FeI_2 , representing

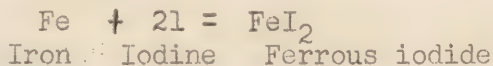
approximately 5 per cent of FeI_2 by weight.

Syrup of Ferrous Iodide may be prepared as follows:

Iron, in the form of fine, bright wire.	20 Gm.
Iodine.	60 Gm.
Hypophosphorous Acid.	5 cc.
Sucrose.	850 Gm.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Place the iron in a flask having a capacity of about 500 cc., add the iodine and 200 cc. of distilled water, and shake the mixture occasionally, checking the reaction if necessary by placing the flask in cold water. When the liquid has acquired a green color and has lost the odor of iodine, heat it to boiling, and dissolve 100 Gm. of sucrose in the hot liquid. Filter the solution at once into a flask, graduated to 1000 cc. and containing the remainder of the sucrose, and rinse the flask containing the iron with 240 cc. of hot distilled water, in divided portions, passing the rinsings successively through the filter. Agitate the mixture until the sucrose is dissolved, warming if necessary, cool to 25°C . add the hypophosphorous acid and enough distilled water to make the product measure 1000 cc. Mix well and strain.

The chemical reaction may generate sufficient heat to volatilize some iodine, and if so, it is necessary to apply cold. Near the end of the reaction the mixture is heated to boiling to complete the reaction, and the liquid should be entirely free from a reddish color. Excess of iron is used as it can be filtered out, whereas excess of iodine being in solution cannot be filtered out. Sugar is added to the solution before filtering and the filtrate is run directly into sugar, to protect ferrous iodide from oxidation. "Crystal A" or "rock candy" sugar should be used, as it is purer and does not become caramelized as quickly. Hypophosphorous acid is added to prevent oxidation and liberation of iodine. The syrup may become red from change of sugar or liberation of iodine, and the remedy for the latter condition is hypophosphorous acid, which changes iodine to hydriodic acid. Direct sunlight with the syrup reduces iodine. The container should be well filled to keep out air. The syrup contains 5 per cent of ferrous iodide by weight, or 7 grams in 100 cc.



SYRUPUS IPECACUANHAE. U.S. Syrup of Ipecac
(Syr. Ipecac.)

Fluidextract of Ipecac.	70 cc.
Glycerin.	100 cc
Syrup, a sufficient quantity,	
To make.	1000 cc
Mix the fluidextract with the glycerin, and add enough syrup to make the product measure 1000 cc. Mix thoroughly.	

In previous formulas, acetic or hydrochloric acid was added to the fluidextract to convert the alkaloids into the soluble salt. This is not necessary now as in making the fluidextract, hydrochloric acid is added in sufficient amount to make the fluidextract mix clear with glycerin and syrup. Glycerin acts as a solvent and also retards fermentation.

Alcohol content -- From 1.5 to 2 per cent, by volume, of C_2H_5OH .

Uses -- A valuable emetic, especially for children suffering from croup; also used as an expectorant in acute bronchitis. In croup it may be given in repeated doses, appropriate to the age of the child, every fifteen minutes until vomiting is produced.

Average dose -- Expectorant, 0.75 cc.
Emetic, 15 cc.

SYRUPUS ZINGIBERIS. N.F. Syrup of Ginger
(Syr. Zingib.)

Fluidextract of Ginger.30 cc.
Alcohol.	20 cc.
Magnesium Carbonate.	10 Gm.
Sucrose.820 Gm.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Mix the fluidextract and the alcohol, and triturate the liquid in a mortar with the magnesium carbonate and 60 Gm. of the sucrose. Then gradually add 430 cc. of distilled water, with constant trituration until the sucrose is dissolved. Filter the solution, and dissolve the remainder of the sucrose in the clear filtrate with the aid of gentle heat; strain the syrup while warm; and when it is cold, add enough distilled water through the strainer, if necessary, to make the product measure 1000 cc. Mix well.

Alcohol content -- From 3.5 to 4.5 per cent, by volume, of C_2H_5OH .

Storage -- Keep the Syrup in well-closed containers, in a cool place.

Uses -- As a vehicle especially in prescriptions for colic and diarrhea.

Average dose -- 10 cc.

SYRUPS

Definition:

Give general uses of syrups.

By what four general methods are syrups prepared?

Why should syrups be stored in recently sterilized bottles?

Why should the containers be completely filled?

What effect would excessive heat at boiling temperature have on syrup?

Will a completely saturated solution of sucrose in water ferment?

Will a diluted solution of sucrose in water ferment?

Explain:

State the objections to a supersaturated syrup.

SYRUPS (Continued)

Define simple solution.

Define saturated solutions.

State common names and synonyms for sucrose.

What are the sources of the U. S. P. sucrose?

Explain what is meant by inversion of sucrose and by invert sugar.

Why do syrups sometimes become yellow?

SYRUPS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 240 cc. by solution with heat. Show Calculations:

Prepare 240 cc. by agitation without heat.

Formula:

State S. G., of U. S. P. Syrup.

Give the advantages and disadvantages in the preparation of syrup by the hot and cold methods.

Describe the appearance of bacterial growth in syrups.

SYRUPUS BALSAMI TOLUTANI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc.

Show Calculations:

Formula:

Why was a small amount of sucrose added to the magnesium carbonate and tincture?

Other than as a filtering agent, what function does the magnesium carbonate serve?

Would a soluble carbonate, such as potassium carbonate, be satisfactory? Why?

Compare your syrup with a sample made from "Fluid Tolu, for syrup".

Uses and doses.

Storage

Description and physical properties.

SYRUPUS FERRI IODIDI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 60 cc.

Show calculations:

Formula:

Why is excess iron added?

Why does caution have to be taken in starting the reaction between the iodine and iron?

Why is sugar added before filtering?

Why does the syrup tend to change color?

Why is this syrup sometimes placed in direct sunlight?

Uses and doses.

Storage and test for iodine.

Description and physical properties.

SYRUPUS IPECACUINHAE

O.E.T. U.S.P. or N.F. ,

Syn. Abbr.

Prepare 120 cc.

Show calculations:

Formula:

Why is glycerin used in preparation of syrup?

Use and doses.

Storage.

Description and physical properties.

SYRUPUS ZINGIBERIS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc.

Show calculations:

Formula:

Use and dose.

Storage.

Description and physical properties.

MUCILAGES

The official mucilages are thick, viscid, adhesive liquids, produced by dissolving gum in water, or by extracting with water the mucilaginous principles from vegetable substances. The mucilages are all prone to decomposition, unless a preservative is added.

MUCILAGO ACACIAE. U.S.P. Mucilage of Acacia

(Mucil. Acac.--Mucilage of Gum Arabic; Mucilage of Gum Acacia).

Acacia in small fragments. 350 Gm.
Sodium Benzoate. 1 Gm.
Distilled Water, a sufficient quantity,

To make. 1000 cc.

Place the acacia in a graduated bottle having a wide mouth and a capacity not exceeding 1000 cc., wash the drug with cold water, allow it to drain, and add enough warm distilled water, in which the sodium benzoate has been dissolved, to make the product measure 1000 cc. After stoppering, lay the bottle on its side rotating it occasionally, and when the acacia is dissolved, strain the mucilage.

Mucilage of Acacia may also be prepared by adding 400 cc. of distilled water to 350 Gm. of powdered or granular acacia, in a mortar and triturating until the acacia is dissolved. Then add the sodium benzoate, dissolved in 100 cc. of distilled water, and sufficient distilled water to make the product measure 1000 cc.

Mucilage of Acacia must not be dispensed if it has become sour or mouldy.

Note--The U.S.P.XI has now added the method of preparation for this Mucilage which is almost universally the custom of the pharmacist. It is important that the powdered or granular acacia be of good quality if the product is to be of satisfactory color and free from foreign substances. By this method the mucilage is more quickly prepared. It is important in using this process to place the acacia in a mortar and quickly add, all at once, at least an equal bulk of the distilled water, and then stir the mixture. If the water is added slowly, a gummy mass results which will dissolve only after hours of standing. The sodium benzoate is added to aid in the preservation of the product.

Uses -- A demulcent; also employed as an excipient in making pills and troches, and as an emulsifying agent for cod liver oil and other substances.

Average dose -- 15 cc.

MUCILAGES

Definition:

List official mucilages.

What effect would long storage and warm temperature have on mucilages as a class?

MUCILAGO ACACIAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 60 cc.

Formula:

Why is it better to add only a small amount of water at first preparing the mucilage from the powder?

State the U. S. P. "caution" and explain.

Description and physical properties.

Use.

EMULSIONS

Some Theoretical Aspects of Emulsions

An emulsion is a heterogeneous system consisting of droplets of one liquid dispersed throughout the body of a second liquid. That liquid broken up or existing as globules is termed the internal, dispersed, or discontinuous phase whereas the liquid enclosing the droplets is termed the external or continuous phase or the dispersion medium.

From the standpoint of the relative amounts of the two phases, there are generally speaking, two very distinct types of emulsions:

(a) The very dilute emulsions of oil in water, usually referred to as the oil hydrosols.

(b) The more concentrated emulsions which are more complex and which may have either oil or water as the external phase.

The oil hydrosols consist of systems in which water is the dispersion medium, throughout which is dispersed very small amounts of oil; never exceeding .2 per cent. The particles of oil which are very small are not protected by the presence of any added stabilizing agent and their behavior is quite analogous to that of hydrophobic sols. Engine condenser water is a common example of this class of emulsions which is of very little pharmaceutical importance.

The second class of emulsions may be subdivided into (1) those consisting of droplets of oil dispersed throughout an aqueous dispersion medium, usually referred to as oil-in-water or O/W emulsions, and (2) those in which droplets of water are dispersed throughout an oleaginous dispersion medium, termed water-in-oil or W/O emulsions.

When pure oil and water are shaken together, the initial dispersion of oil is quite unstable, the oil rapidly coalescing until a complete separation into a layer of oil and water results. This is as might be expected, inasmuch as the increase in surface area produced by the dispersion of the oil, greatly increases the free surface energy of the system. By the process of coalescence this free surface energy again attains its minimum value. Free surface energy is dependent upon both surface area (capacity factor) and interfacial tension (intensity factor). Obviously the former cannot do other than increase when the surface area is increased during dispersion. Therefore if a stable emulsion is to be produced, there must be present some third substance termed the emulsifying or stabilizing agent which in some manner or other can prevent the coalescence of the oil globules. The mechanism whereby this coalescence is prevented is explained in several ways by numerous theories which have been advanced in the extensive emulsion literature.

DETERMINATION OF EMULSION TYPE -- Frequently emulsions must be classified as to whether they are of the oil-in-water or water-in-oil type. Generally speaking, an emulsion is miscible with a liquid which is miscible with its external phase. Thus an O/W emulsion is easily mixed with water and a W/O emulsion is easily diluted with oil, but not vice versa. A second method is a qualitative observation with regard to the electrical conductivity of the system, the O/W acting as an efficient conductor and the W/O permitting only a slight flow of current through the system. A third and very useful method is the use of oil-soluble or water-soluble dyes in which the phases are selectively stained and their relative positions observed microscopically. Finally, use may be made of the difference in refractive index between oil and water in which case a globule of the dispersed phase is focused carefully under the microscope. Observing the Becke line, which is the halo of light seen when the globule is just slightly out of focus, it will be found to move into the medium of higher refractive index when the objective lens is raised. Thus if it moves toward the center of the globule, an O/W emulsion is indicated, and if it moves toward the periphery, a W/O emulsion is indicated, realizing that the refractive index of oils exceeds that of water.

INVERSION OF PHASES -- An emulsion of the oil-in-water type can be transformed to the water-in-oil type by the addition of either an emulsifying agent of the opposite type or some salt that will react with the O/W emulsifying agent to form one favoring the W/O type. For example, if an O/W emulsion stabilized by the presence of sodium oleate is shaken with some calcium chloride, the O/W emulsion will invert to the W/O type. This is due to the reaction between the sodium oleate and the calcium chloride forming calcium oleate which will dissolve in the oil phase, causing it to assume the external position with respect to the aqueous portion which now becomes the internal phase. In a like manner, sodium hydroxide added to a W/O emulsion stabilized by a divalent metal soap will invert the emulsion, forming an O/W emulsion.

Under certain conditions it is possible to cause an inversion of phases simply by varying the relative volumes of oil and water. That ratio at which inversion occurs is called the critical ratio.

EMULSIFYING AGENTS -- The third substance which must be present in order to form stable oil-in-water (O/W) or water-in-oil (W/O) emulsions is called the emulsifying, dispersing, or stabilizing agent. It is sometimes referred to as the third phase in the emulsion system. Mention has already been made of the fact that as a rule one can predict the emulsion type on the basis of whether the emulsifying agent is oil or water soluble, the phase in which it is soluble being the dispersion medium.

One very important point of difference exists between various emulsifying agents. Some, by reason of certain physical properties, notably viscosity and viscidty, favor dispersion due to mechanical forces which are brought into play. These are pre-eminently, dispersing agents. Others are not so effective from the

standpoint of dispersion but they are excellent stabilizers, i.e., once the dispersion has been accomplished coalescence is effectively prevented. For example, tragacanth is a very excellent dispersing agent but a poor stabilizer, whereas gelatin is a poor dispersing agent but one of the most effective stabilizers.

Due to the very considerable number of emulsifying agents that are available no attempt will be made to do other than to discuss briefly those of outstanding importance pharmaceutically. For the purpose of classification they will be divided into (a) those favoring an oil-in-water and (b) those favoring a water-in-oil emulsion.

OIL-IN-WATER EMULSIFYING AGENTS -- This group is comprised of various hydrophilic colloids, i.e., those possessing a marked affinity for water, forming colloidal solutions, e.g., proteins, gums, carbohydrates, soluble soaps. Some of the more common substances are acacia, tragacanth, mucilage of chondrus, egg yolk, agar, soap and gelatin. These substances have been used quite considerably in the past in the preparation of oil-in-water emulsions for internal administration, the primary object being the preparation of a suitably flavored product which would make the oral administration of fixed or mineral oils less disagreeable. Soap is used as an emulsifying agent in many external preparations. Occasionally emulsification becomes a pharmaceutical necessity when oil and aqueous materials are required together in a prescription. Practical information concerning the proper use of these and other emulsifying agents in regard to amounts required and the technic to be employed will be found in Part II, page 1629 (Remington's Practice of Pharmacy).

Gelatin has recently been investigated as a practical emulsifying agent and when used under proper conditions it gives promise of becoming a very useful stabilizing material possessing many advantages over some of the more commonly employed substances.

Among some of the more recently developed emulsifying agents are glyceryl monostearate, triethanolamine stearate, triethanolamine oleate, sulfonated castor oil, sulfonated fatty alcohols, ammonium linoleate, diglycol oleate, diglycol stearate, and many others.

Some of these substances are used in preparing O/W cosmetic creams, usually referred to as "vanishing creams," which are semi-solid emulsions. In addition, they may be used to prepare "brushless shaving creams" and other cosmetic preparations of the O/W type.

WATER-IN-OIL EMULSIFYING AGENTS -- This group consists of various oil soluble compounds which when added to oil favor the dispersion of water throughout the external oil phase. Among the more important substances are wool fat, or lanolin, cholesterol, oxycholesterol, the soaps of the divalent metals, magnesium, calcium, barium, strontium, and zinc, and trivalent aluminum, sperma-

ceti, white wax, phytosterol, oxidized soya bean oil, and many other substances which are often trademarked. These substances produce liquid emulsions of the carron-oil type which are quite unsuited for internal administration but which in many cases are most desirable for external medication. Semi-solid emulsions with these substances provide the cold cream or cleansing cream type of product, a very widely used class of products.

Lecithin is a unique emulsifying agent in that it will stabilize either an O/W or a W/O emulsion, being dispersed by either water or oil. Generally speaking, the type of emulsion obtained will depend on the relative volumes of oil and water employed, and the technic used. If an O/W emulsion is desired, the lecithin should be dispersed in the water and the aqueous phase should be at least equivalent to the volume of the oil to be used. If the W/O type is required the reverse should be true. The use of a synergistic emulsifier also will be a determining factor.

SYNERGISM AND ANTAGONISM EXHIBITED BY A COMBINATION OF EMULSIFYING AGENTS -- It is frequently desirable to combine various emulsifying agents in order to provide more efficient action than would be obtainable with a single substance. Thus acacia and tragacanth or acacia and agar are frequently combined to unite dispersing and stabilizing properties.

In some cases antagonistic qualities are seen which of course make such combinations quite undesirable. Obviously, the blending of two emulsifying agents, one favoring an O/W system and the other a W/O, is certain to cause difficulty and this should never be done. However, certain antagonisms are found within a single class of emulsifying agents. Notable is the antagonism exhibited by cholesterol and lecithin and that found with gelatin (at a lowered pH) and agar. The latter case is explained by the phenomenon of mutual flocculation. Agar, a negatively charged colloid, is precipitated by the highly positive gelatin producing a flocculent precipitate. Therefore, such a combination is not feasible.

TRANSPARENT AND CHROMATIC EMULSIONS -- Emulsions as usually prepared are opaque and white or nearly so. This is due to the optical heterogeneity of the system, incident light being almost totally reflected from the emulsion. If the two phases comprising the emulsion system are so adjusted as to be of the same refractive index then the emulsion system becomes optically homogeneous and the emulsion transparent. If in addition the two phases have widely different optical dispersive powers, the system is analogous to a multitude of lenses or prisms and a prismatic color effect results.

MULTIPLE EMULSIONS -- Multiple emulsions are those in which the globules of the dispersed phase contain globules of the other phase. This condition frequently occurs as the result of inversion.

CONCENTRATION OF EMULSIONS AND PARTICLE SIZE -- If the dispersed phase of emulsion consisted of perfectly uniform globules, then the maximum part of the total volume of the emulsion which they could occupy would be 74.02 per cent. Actually, under certain conditions, emulsions containing more than this amount of dispersed phase have been prepared due to a lack of uniformity in the particle size which allows smaller globules to fill in the spaces between larger ones, and further due to a deformation of the globules themselves.

Obviously, when the dispersed phase exceeds approximately 74 per cent, conditions are not such as to favor prolonged stability, yet from the creaming standpoint an emulsion of this concentration would seem to provide ideal conditions.

The particle size of an emulsion is a factor subject to considerable variation. Not only may the particle size vary in different emulsions but there may also exist a great variation in particle size within a single emulsion.

The determination of the statistical distribution of the size of dispersed particles in a dispersion is termed a size-frequency analysis. This may be done by measuring the diameters of the particles observed in numerous representative microscopical fields or by a sedimentation method. A size frequency analysis is of considerable value in predicting creaming tendency as well as useful in determining emulsion stability. A rapid growth in average particle size indicates, of course, an emulsion not possessing marked stability under the existent conditions.

SPLITTING OF EMULSIONS -- CHEMICAL AND PHYSICAL METHODS. The splitting of emulsions frequently termed deemulsification may be accomplished by several methods, the choice being determined by the particular emulsion at hand. This process is not as important in pharmacy as in many other fields. The only important application in pharmacy is the analysis of emulsions for oil content where some highly efficient deemulsification technic is indicated.

Among the methods commonly employed are--

1. Use of heat or cold.
2. Centrifuging.
3. Addition of emulsifying agent favoring reverse type.
4. Addition of electrolytes.
5. Destruction or coagulation of emulsifying agent.
6. Addition of liquid in which both phases are soluble.
7. Electrical methods.

One of the most efficient methods for small scale application to O/W systems is freezing with solidified CO₂, followed by ether extraction of the oil phase.

The use of the Cottrell precipitator is an example of an electrical method of deemulsification in which the emulsion is subjected to the passage of high potential alternating current, resulting in a coalescence of the two phases.

MECHANICS OF EMULSIFICATION--EMULSIFYING EQUIPMENT--

In the actual preparation of emulsions, a wide variety of methods is employed. The simplest procedure is that of ordinary agitation or shaking. This method is frequently employed by the pharmacist, particularly in the emulsification of oils of low viscosity, which are easily dispersed. Some claim that under certain conditions intermittent shaking is considerably more effective than ordinary continuous shaking, which is explained as due to the fact that continuous shaking tends to break up not only the phase to be dispersed but the dispersion medium. This of course, impairs the ease of emulsification. Laboratory shaking devices are available which may be used for the small scale production of emulsions by this method. Others call attention to the fact that shaking is an inferior method of making emulsions "because, as the emulsion becomes more perfect, the smashing action between the relatively heavy and light particles becomes more feeble, whereas the smashing forces should be increased."

There are many types of agitating devices or churns marketed for purposes of emulsification. These differ not only in efficiency but also in regard to the optimum conditions for their operation due to their difference in construction, speed, and size.

The mortar and pestle is a common piece of small scale pharmaceutical equipment which is widely used by the prescription pharmacist in the extemporaneous preparation of emulsions. It has very definite limitations, however, since its usefulness depends largely on certain physical properties of the emulsifying agent employed, chiefly its viscosity. Attempts to use the mortar and pestle with an emulsifying agent lacking this viscosity, e.g., a gelatin solution, are doomed to failure regardless of the fact that in so far as stabilizing influence is concerned it may be excellent.

The small electric mixer is admirably adapted to the preparation of emulsions at the prescription counter. It is generally available in some pharmacies and will save time and energy, producing satisfactory results with acacia, and agar-type emulsions but not those prepared from gelatin.

Modern emulsifying devices include various types of colloid mills, viscolizers, and homogenizers. The principle of operation of the colloid mill is the passage of the mixed phases of an emulsion formula between a stator and a high speed rotor which is revolving at from 2000-10,000 r.p.m. The clearance between the rotor and stator is adjustable usually from 0.002 in. upward. The emulsion mixture in passage between the rotor and stator, is subjected to a tremendous shearing action which causes a fine dispersion to take place. There are several types of colloid mills on the market, all operating along the same general lines but different from one another sufficiently to make their relative efficiencies greatly different.

The viscolizer and homogenizer operate on the same general principle. The mixed phases are caused to pass between a finely ground valve and seat under very high pressure. This produces in effect an atomization which is assisted by the impact received by the atomized mixture as it strikes the valve head. This type of apparatus is made to operate at pressures of from 1000 to 5000 lbs. per square inch and it produces probably the finest dispersion obtainable in a liquid emulsion.

Homogenization may be used as the sole process of emulsification following an initial rough agitation of the mixed ingredients or it may be applied to an emulsion prepared by other means for the purpose of both decreasing the particle size and bestowing a greater degree of uniformity.

Two-stage homogenizers are so constructed as to conduct the emulsion after treatment in the first valve directly to another where it receives a second treatment. In certain emulsions a single homogenization produces an emulsion which, although its particle size is small, has a tendency to clump or form a cluster. This increases the creaming tendency and it is corrected by passing the emulsion through the first stage at a high pressure, e.g., 3000 to 5000 lbs. per square inch and then through the second stage at a greatly reduced pressure, e.g., 1000 lbs. per square inch. This accomplishes a breakdown of the clusters formed in the first step.

One point of superiority in regard to the homogenizer is the fact that it does not beat air into the product. Many emulsions can be ruined by this factor alone, due to the preferential adsorption of the emulsifying agent at the air/water interface followed by an irreversible precipitation termed denaturation. This is particularly prone to occur with protein emulsifying agents.

There is one phase in homogenization which should not be overlooked. It is quite possible to spoil an initial emulsion by homogenization if there is not a sufficient excess of emulsifying agent to take care of the increase in surface area accomplished by the homogenization.

Temperature plays an important role in the process of emulsification where homogenization is employed. As a general rule an elevated temperature increases the ease of emulsification, due first to a reduction in viscosity and second to the fact that as a rule the interfacial tension between oil and water is reduced by a rise in temperature.

Some Practical Aspects of Emulsions.

There are many opportunities in the daily routine of the pharmacist technician to apply a knowledge of emulsions and emulsification. Not only are specific emulsions called for, but

prescriptions are frequently received which require special treatment involving suspension or perhaps emulsification of some ingredient.

Two methods in the preparation of emulsions, originally European, are available. One is called the English method, while the other is spoken of as the Continental method. They will be considered individually.

THE ENGLISH METHOD--This is the slower of the two methods and calls for considerable care and skill, and a recognition of the various possible conditions which should develop or which may develop, lest the emulsion be spoiled. In the English method the emulsifying agent is always used in a liquid form as represented by mucilages of acacia, tragacanth, or chondrus, agar solution, egg yolk, etc. This requires, as in the case of acacia which is preferably used, that a thick mucilage be prepared. To develop a satisfactory mucilage of acacia, granular acacia should be mixed in a mortar with an equal quantity of water, added all at once and simultaneously triturated with the pestle. This procedure will eliminate lumps and produce a smooth mucilage in a very short time. It is advisable to dilute this original mucilage slightly by the addition of a little more water. The amount of acacia to use is usually one-quarter of the amount of oil to be emulsified, although a smaller quantity may serve the purpose equally well.

The emulsifying agent is placed in a dry mortar and a small quantity of the oil is added. The pestle is rapidly and lightly rotated away from the body from right to left with the effect of dashing the oil into globules, which are prevented from coalescing by the intervention of the emulsifying agent. It will probably be advisable to add and incorporate an additional portion of oil at this point, but as the emulsion progresses and the nucleus grows it will become necessary to add water occasionally to maintain the proper consistence. When to add water and when to add oil is a question which must be mastered by those who attempt to use the English method. It may resolve itself into a case of alternating one with the other but the question depends entirely upon how much of either is added at a time. If too much water is added and the emulsion becomes too thin, it will be impossible to emulsify additional oil. Likewise if not enough water is added, the emulsion becomes too thick and "cracks" because there is not enough aqueous mucilage to cover the globules of oil which are present. The emulsion must be kept of such consistence that the pestle makes a characteristic crackling sound as it spins around the mortar. This crackling sound is due to the thick emulsion, or mucilage, stretching out between the sides of the mortar and the pestle and snapping back as it finally breaks away from one or the other. The emulsion at this stage should be smooth and creamy in appearance and show a high uniform gloss throughout. When "crackling" develops, the emulsion loses its uniform gloss and takes on a "pearly" appearance, showing a definite sheen and evidence of free oil globules. Should this occur it is often possible to save the emulsion by setting it aside for a few minutes when it will be noticed that the separation progresses. Much of the air which has likely been beaten into the emulsion separates, and the oil and the

aqueous phases become more pronounced. If water is now judiciously added and the mixture triturated, the emulsion will immediately return to normal. If too little water has been added, discontinue the trituration, set the emulsion aside for a few minutes, then add more water and triturate. Of course, if too much water has been added the emulsion may become so thin that it will be impossible to emulsify any additional oil. In this case a new mucilage may be prepared and the broken emulsion reclaimed by adding it slowly to the new mucilage. When all of the oily mixture has been incorporated, the emulsion may be brought up to its final volume by the addition of water, preferably added in small portions.

It must be remembered that the smaller the oil globule, the slower the rate of creaming and, according to Stokes' law if an oil globule is cut in half, the creaming rate is reduced to one-quarter. Consequently, the more trituration given to an emulsion while it is still in its original thick condition, the more perfect the finished emulsion will be.

THE CONTINENTAL METHOD ("4-2-1 Method")--The Continental method will produce an emulsion much more quickly than the English method and is therefore usually preferred to the latter. It has the real merit of never failing to produce a good emulsion if the proper proportions are maintained in forming the nucleus, and if the directions are strictly followed. The most satisfactory proportions for most oils, such as olive oil, cod liver oil, and castor oil, may be easily remembered. They are: "One-half as much water as oil, and one-half as much acacia as water"; or, as it is usually expressed, "4-2-1" (4 oil, 2 water, 1 acacia.) This produces only the "nucleus," although all of the oil is emulsified. It is essential that additional water be finally added to dilute the emulsion to the proper strength. The oil is placed in a dry mortar or emulsion machine, the amount of oil depending upon the quantity or percentage directed in the prescription or formula. Add the acacia in fine powder, to the oil, mixing them intimately. (Powdered acacia is the only natural gum which produces a good emulsion by the Continental method where a mortar and pestle are used.) Then add, all at once, the 2 parts of water, at the same time stirring vigorously with the pestle. Within a few seconds the acacia is dissolved in the water and the mucilage thus formed envelops the oil globules which result from the active stirring of the mixture. Considerable skill is required in handling the mortar and pestle at this point. The trituration must be fast, it must cover the entire contents of the mortar, maintaining an intimate mixture of the material at all times, and it must be continued until the mixture becomes very thick and a perfect "nucleus" is formed. The error of stopping the trituration too soon is very common, and attention is again called to the Stokes' law in this respect. After the nucleus has been properly prepared, additional water may be added at will.

The powdered acacia should not be triturated with the oils, more than just enough to mix the two intimately, because

acacia not only contains water-soluble constituents but also oil-soluble portions, such as salts of magnesium, which will tend to produce "water in oil emulsions." Naturally, such a condition is likely to destroy the possibilities of obtaining a satisfactory "oil in water emulsion."

The necessity of using dry containers, the importance of observing the ingredient ratio, the advisability of measuring the oil in a dry graduate, the requirement that the two parts of water be added all at once, and finally the necessity of rapid and continued trituration, cannot be over-emphasized.

A definite technic for handling a pestle must be developed in making emulsions. The pestle should be lightly held between the thumb and the first two fingers and it should be rotated entirely by a finger and wrist motion to obtain the speed which is highly essential. The head of the pestle should be forced against the curve of the mortar and not rotated with a purely circular motion in order to produce a shearing action on the oil globules.

In making Continental emulsions of some oils, other than the standard cod liver oil, or castor oil type, it is necessary to change the proportions of the ingredients. Oil of turpentine is better prepared from a mixture of "oil 3, water 2, and acacia 1." Some pharmacists prefer to emulsify liquid petrolatum on the basis of "2,2, and 1".

A combination of the Continental and the English method has certain advantages. If the former method is used for about one-half, or a little more than one-half of the oil, the remainder of the oil may be added to the original nucleus by the English method. This procedure requires only half as much acacia as would be needed if the Continental method alone were followed. It is faster than the English method only, and the resulting emulsion is more fluid and more readily poured than when more acacia is used.

Formulas and directions for the official emulsions will be found, beginning on page 311. (Practice of Pharmacy, Remington's). Among them are several examples of emulsions prepared by the Continental method, and others of a special nature.

Emulsifying Agents.

ACACIA--Many of the essentials of acacia as an emulsifying agent are discussed on pages 1629 to 1631. (Remington's) For general use with a mortar and pestle, it far surpasses any other agent. Attention was called above to the possibility of water in oil (W/O) emulsions being formed accidentally with acacia. This condition is also intensified when the mixture is heated as was directed for the formerly official emulsion of petrolatum. Acacia is reported to be stable as an emulsifier in preparations

ranging in pH from 2 on the acid side to 11 on the alkaline side. Powdered acacia should be used for Continental emulsions and granular acacia is preferable for making a mucilage of acacia because of its rapidity of solution, although the whole acacia, if it is given time to dissolve, produces a far clearer and finer mucilage.

TRAGACANTH--This is not a good emulsifying agent by itself, producing coarse emulsions containing large globules of oil. However, when it is used in conjunction with good emulsifiers, it produces the necessary viscosity to prevent rapid creaming. Thus, it is frequently used with acacia in the preparation of many commercial emulsions.

AGAR--Agar is likewise not a good emulsifying agent when used alone, but when it is used with another substance such as acacia, as in the N.F., Emulsion of Liquid Petrolatum with Phenolphthalein, it adds to the perfection of the emulsion. It can only be used in the form of a solution, and this must be kept warm as it will gel at about 40° C. At higher temperature it remains liquid but too high a temperature may prevent the formation of an emulsion, depending upon the method employed for emulsification and upon the character of the formula used. Agar must be actively boiled with the water to obtain a complete and reasonably quick solution, but care must be observed lest the solution burn on the bottom of the container. It is often desirable to strain it while hot to remove traces of any undissolved particles. An agar solution should be colorless or nearly colorless.

The linking of agar with liquid petrolatum in an emulsification is not, as was originally claimed, the "scientific" combining of two laxative agents. Agar in a liquid form, as in an emulsion, has lost all of its opportunity to act as a laxative and is present solely as an aid to emulsification. The ridiculously small quantity present, in terms of the amount of agar required for a laxative purpose, is but another evidence of an over-enthusiastic and misdirected advertising genius.

Emulsion of Liquid Petrolatum With Phenolphthalein possess a bitter taste when first prepared, but this bitter taste disappears within a few days. The bitterness is believed to be due to the phenolphthalein being temporarily suspended in colloidal form, as colloidal phenolphthalein is known to be bitter. On ageing, it soon returns to normal and is tasteless.

GELATIN--Gelatin has long been referred to in many texts as an emulsifying agent, but it is only recently that workable methods have been developed for its general use. The pharmacist usually thinks of emulsion in terms of the prescription counter and the use of a mortar and pestle, but it is impossible to produce a satisfactory emulsion with gelatin as the emulsifying agent in this manner. It is a splendid protective colloid but it requires that the oil, which it is to protect, must be brought to it as finely dispersed globules. This condition can only be obtained by the use of a homogenizer which tears the oil globules to pieces

under enormous pressures.

Gelatin suitable for emulsification purposes must also possess certain characteristics which are not inherent to all gelatins. These characteristics which make gelatin a good protective colloid for pharmaceutical emulsions, are largely dependent upon the source of the gelatin. Only that made from pig-skin (porkskin) is suitable. That made from calfskin or bones cannot be used under the conditions which are imposed. Gelatin as an emulsifying agent for pharmaceutical emulsions gives the best results when the emulsion is adjusted to a pH of about 3 to 3.2. Below a pH of 3 the acid taste is objectionable. However, the two basic types of gelatin do not produce identical results at this pH, the apparent reason being found in the difference in their isoelectric points. Pigskin gelatin possesses an isoelectric point of about 8 on the pH scale; while that of the calf-skin or bone type is about pH 4.7. Consequently when the pH of a gelatin is adjusted, there are considerably more positive charges developed in changing the pork-skin gelatin from 8 to 3.0 than there are in the corresponding change for the calf-skin type which only goes from 4.7 to 3.0. Therefore, when gelatin is used as a protective colloid, the greater number of available charges on the pork-skin gelatin, and its high degree of hydration make it far more efficient than the calf-skin or the bone variety.

The adjustment to a definite pH may be made with either hydrochloric acid or tartaric acid. If the former is used, the pH is adjusted to 3 while with tartaric acid the adjustment is made to 3.2, which seems to produce a more palatable preparation.

Gelatin emulsions show a tendency to lose some of their viscosity upon ageing, due to the hydrolysis of the gelatin. This change in the product may be overcome by heating the gelatin solution nearly to the boiling point for about fifteen minutes before it is used.

The amount of gelatin to use is approximately 1.2 per cent of the oil content of the emulsion. Accordingly, the U.S.P. XI Emulsion of Petrolatum would be prepared as follows if gelatin were used to replace the acacia:

Liquid Petrolatum.	500 cc.
Porkskin Gelatin (250-275 Bloom).	6 Gm.
Hydrochloric Acid or Tartaric Acid, sufficient for a pH of 3 or 3.2.	
Syrup.	100 cc.
Vanillin.	0.04 Gm.
Alcohol.	60 cc.
Distilled Water, sufficient	
To make.	1000 cc.

To 340 cc. of cold water add the gelatin and the necessary amount of acid as previously determined. Allow the mixture to stand for a few minutes and then raise the temperature and stir the

mixture until the gelatin is dissolved. Heat the solution at almost the boiling point for about fifteen minutes. Add the syrup, the vanillin, previously dissolved in the alcohol, and then sufficient distilled water to make 500 cc. While still quite warm (50° - 60° C.) add the dispersion and then homogenize it, returning the emulsion to the homogenizer a few times to assure a fine and uniform dispersion.

The resulting emulsion is very white, indicating a fine dispersion of "oil" globules. It is extremely thin, which means that it will be much more pleasing to take. It will show very little tendency to cream. It is economical when compared with the relative costs of other emulsifying agents. The emulsion is not subject to proteolytic bacterial decomposition at a pH of 3 and the alcohol effectively preserves it from molds and yeasts.

Gelatin should preferably be used by itself rather than combined with another emulsifying agent. For instance, if it is used in conjunction with agar, which is negatively charged, the charge of the one will neutralize the charge of the other, resulting in a mutual flocculation and emulsification will be impossible.

CHONDRUS--In the form of a heavy mucilage, chondrus is used in the same manner as mucilage of tragacanth. It is not an efficient emulsifying agent for prescription work but finds its greatest use in the industry. The mucilage must be freshly made from clean chondrus and it requires the use of a preservative to prevent its decomposition.

For emulsions, use double the strength of the N.F. mucilage.

EGG YOLK--This is officially used in preparing an emulsion of cod liver oil and produces a splendid emulsion, which must however, be carefully preserved. The emulsion can best be preserved with alcohol. Egg yolk is quite satisfactorily used in weak acid emulsions: the one time largely used Phosphatic Emulsion and the official Linimentum Terebinthinae Aceticum are examples. It also has the advantage over many emulsifying agents in its usefulness not being destroyed upon the addition of salts, syrups, etc.

QUILLAJA--In the form of the tincture, quillaja produces very good emulsions with oils. Its value lies in its saponin content. Quillaja emulsions have a disagreeable taste and quillaja has toxic properties. Therefore it is used in external preparations only. Its emulsifying properties are not destroyed by acids.

SOAP--This has excellent stabilizing powers, the famous emulsion of Pickering having been prepared from but 1 cc. of a 1 per cent solution of sodium oleate and 99 cc. of liquid petrolatum. Everyone is familiar with the exceptional "stretching" quality of a weak soap solution, as exemplified in a soap bubble, where a very small amount of the solution may be made to expand to a great

surface area before the bubble finally explodes. It is this feature which is indicative of the value of soap as an emulsifying agent.

An official example of what is actually a soap emulsion is found in Linimentum Ammoniae, where ammonia water and oleic acid react to form a soap which in turn emulsifies the sesame oil. Soap, however, is not satisfactory for internal administration, but it is extensively used for external preparations, the mono-valent soaps producing O/W emulsions while the bi- and tri-valent soaps produce W/O emulsions.

For the preparation of O/W emulsions, as for lotions, Liniment of Soft Soap will be found to be the most satisfactory form available. The amount of soap to use will depend upon what will be required of it, both the amount of oil and dilution factor being important. Weak solutions, 1 per cent or less, are usually preferred. It must be remembered that because of its chemical nature, soap emulsions will be destroyed by certain ionizing salts and acids.

The use of certain soaps which produce W/O emulsions is quite common in prescriptions or preparations for external use. An official example of W/O emulsion is found in Lime Liniment (Carron Oil) in which emulsification is accomplished through the formation of a soap when the lime water and linseed oil are mixed together. The soap which is formed is calcium oleate, which in turn immediately assumes the role of an emulsifier, producing a smooth, creamy preparation. This type of reaction is typical of many which are found in daily practice, noticeably in dermatologic lotions containing such ingredients as olive oil, lime water, calamine, zinc oxide, resorcinol, boric acid, phenol, camphor, salicylic acid, and others. An official example is found in Linimentum Calaminae. Salts or preparations of calcium, magnesium, zinc, aluminum, iron, etc., will form soaps with oleates and stearates. These soaps are oil-soluble and consequently lower the interfacial tension of an oil-water mixture on the oil side, thus making it possible for the oil to envelop the globules of water, producing a W/O emulsion.

In extemporaneous lotion prescriptions there are many factors which may or may not favor emulsification. If a soap is to be produced, as in a lime water-oil mixture, the oil must have a sufficiently high acid value, due to free oleic acid, to react with the calcium hydroxide. Sometimes it is necessary to add a small portion of oleic acid to obtain the desired results. If such substances as boric acid and salicylic acid are present, it may become necessary to add a small portion of wool fat to aid in the emulsification. Substances like zinc oxide and calamine favor the production of W/O emulsions and may help to overcome the antagonistic effect of acids such as those mentioned. The proportion of oil-water should not be less than 1 to 1 and prescriptions are frequently received which contain only about one-third as much oil as water, making it impossible to emulsify all of the latter. In

such cases it is advisable to change the system and prepare an O/W emulsion, omitting lime water if it is present, for it only serves as an emulsifier for the W/O type.

Emulsifiers, other than the bi- and tri-valent soaps are available for W/O emulsions of the lotion type and they will be discussed in the following pages.

WOOL FAT AND RELATED PRODUCTS--Wool fat is a frequent adjunct to prescriptions where W/O emulsions are desirable. An example of its ability to absorb water is found in the official hydrous wool fat which contains approximately 25 per cent of water and still remains as a solid unctuous body. A small portion of wool fat usually suffices as an emulsifying agent and it should be melted and mixed directly with the oil. Numerous preparations, related to wool fat, have been placed upon the market in recent years. Basically, they are made by adding 5 per cent of cholesterin (cholesterol) (The active constituent of wool fat) to petrolatum. In some the cholesterin content may be as high as 10 per cent. Typical preparations are known by trade names, such as Aquaphor, Protegin, Protegin X, Eucerin, Thoreps, etc. They are largely used in the cosmetic industry. Cholesterin itself may be added to an oil as an emulsifying agent.

OTHER W/O EMULSIFIERS--Specific examples of additional W/O emulsifiers not previously mentioned by name are: Magnesium stearate and oleate, aluminum stearate and oleate, cetyl alcohol, and magnesium hydroxide.

OTHER O/W EMULSIFIERS--Other emulsifiers of the O/W variety are as follows: Lecithin--This is primarily an O/W emulsifier, but may produce W/O emulsions if it is first mixed with the oil and the water then added. Albumen--An emulsion made from this substance must be carefully preserved, as it is subject to ready decomposition. Sodium Borate--this is indirectly an emulsifier in ointment of rose water and similar products; it hydrolyzes to sodium hydroxide which in turn forms some soap which acts as the real emulsifier. Glyceryl Monostearate--This substance is primarily used in the cosmetic industry and is obtainable under such trade names as Tegin, Xerol, and others; triethanolamine oleate and stearate; triethanolamine itself, as well as sodium and potassium hydroxides also act indirectly as emulsifiers by saponifying any free fatty acids which may be present, the resulting soap actually being the emulsifier. An official example may be found in the case of Mistura Copaiba. In this preparation the solution of potassium hydroxide forms a soap with the resin acids of the copaiba.

GUM RESIN EMULSIONS--These products, as prepared from asafetida, ammoniac, etc., are really misnomers. They are not true emulsions but are suspensions. In making them the material should be crushed and only a small portion of water added at first, just sufficient to make a heavy paste. When this becomes uniform, additional water is gradually added with constant stirr-

ing. This procedure will produce a product of the best type, as hasty manipulation will not completely dissolve or suspend the material.

SEED EMULSIONS--These are made by trituration oily seeds such as almond, with water and are examples of prepared emulsions where no added emulsifying agent is required, since all of the factors favorable for emulsification are in the seeds themselves. The same procedure should be followed in preparing them as in directed for gum resin emulsions.

EMULSION OF PHENYL SALICYLATE (SALOL)--Prescriptions are frequently encountered in which the physician has written for salol, olive oil, or almond oil, and a vehicle such as water. Prescriptions of this type are to be compounded by dissolving the salol in the oil and with the aid of a little heat, and then proceeding in the usual manner to make an emulsion. The total volume of the salol-oil solution is taken as the basis for calculating the amount of acacia which will be required, and the emulsion is prepared by the Continental method. The salol-oil solution should be allowed to cool to room temperature before emulsification is attempted.

When salol is prescribed in a liquid prescription and no oil has been included, it is the duty of the technician to dissolve the salol in a little oil and emulsify it, in order to dispense a suitable product. Salol is insoluble in water and does not lend itself to satisfactory suspension.

EMULSIONS OF VOLATILE OILS--Emulsion of Turpentine, a type of volatile oil emulsion, is official. It is made by what has been called the Forbes' method, a modification of the Continental method. This is suitable for oils which are light in body and capable of being dispersed into minute globules by shaking in a bottle. This procedure may also be used for other volatile oils, but another common method is first to mix the volatile or lighter oil, with a bland fixed oil. The latter gives sufficient viscosity or body to the mixture to allow the use of the regular Continental method.

An efficient emulsifier for volatile oils has been suggested. It consists of a mixture of 20 per cent of powdered egg albumen and 80 per cent of potassium bitartrate. Only a small portion of this emulsifying agent is required, as for example: mix 1 Gm. of the agent with 100 cc. of volatile oil, agitate thoroughly, and add 100 cc. of water and agitate for about one minute. This proportion is satisfactory for volatile oils which are heavier than water. For volatile oils lighter than water, use about two and one-half times as much emulsifying agent.

FLAVORS--The question of flavors for emulsions is important. An emulsion, otherwise satisfactory, may be spoiled by the addition of an unsuitable flavor or an excess of flavor. Flavors should not be considered in terms of single doses of the emulsion

but with a realization that the preparation may be taken over a prolonged period. What might be an acceptable flavor for one dose may become very objectionable when it is constantly repeated. The flavor should give but a slight taste and should not be prolonged. An examination of the official emulsions will serve as an example of practical flavoring, should the technician be called upon to flavor an emulsion.

ADDITION OF SALTS, SYRUP, ETC.--The addition of salts, such as are frequently called for with emulsions, the addition of syrup as a flavoring agent, and the addition of alcohol as a preservative offer numerous problems to the technician, lets the emulsion be broken. As a general rule such ingredients should be dissolved in or diluted with water and emulsified. Many of the salts will ionize in solution, and if carelessly added to the emulsion will destroy the charge of the emulsion and cause oil to be liberated. If salts are added in a concentrated form, they may break the emulsion by a dehydration process, taking water away from the interface.

The addition of an acid may serve to destroy a protective colloid such as soap, while the addition of an alkali would destroy the action of gelatin in the same manner. Syrup, added in a concentrated form, may cause the emulsion to break, due to the osmotic change which it induces at the interface. Alcohol may act in a similar manner and it also presents another hazard, that of precipitating protective gums such as acacia, which is insoluble in it.

If an ingredient in an emulsion prescription or formula is soluble in a substance which is to become the inner or dispersed phase, it should be dissolved in the substance first, before any attempt is made to make the emulsion. Failure to follow this procedure may lead to the breakdown of the interfacial protective film when the material is added later.

PRESERVATIVES--Emulsions in which gums and similar organic substances act as the emulsifying agents are very prone to decomposition, either by mold, yeast, or proteolytic fermentation. Preservatives must always be used in such instances and several suggestions are available. Alcohol is frequently used for this purpose, 10 per cent being the amount which is necessary for proper protection. Benzoic acid is also quite satisfactory in quantities of one-tenth of one per cent.

EMULSUM ASAFOETIDAE USP Emulsion of Asafetida
(Emuls. Asafoet.--Milk of Asafetida; Asafetida Mixture)

Asafetida, in tears or selected masses. 40 Gm.
Distilled water, a sufficient quantity,
To make. 1000 cc.

Rub the asafetida in a mortar with 900 cc. of distilled water, at first very gradually added until a uniform emulsion results. Then strain the mixture into a graduated vessel, and rinse the mortar and strainer with enough distilled water to make the product measure 1000 cc. Mix thoroughly.

Uses--A carminative frequently administered to infants for colic, either by mouth or by rectum. Powdered asafetida should never be used to replace the gum resin, since the most active constituent, the volatile oil, has been largely driven off in drying before powdering. The addition of the tincture to water, in the preparation of a milk of asafetida, as has been suggested, is also objectionable and should never be practiced, while concentrated glycerites should also be looked upon with suspicion as producing an inferior product. The only proper way to make this emulsion is from asafetida in tears. This preparation may also be made by suspending the tears, contained in a muslin bag, in the water in a bottle. In a few hours, the drug will disintegrate and become distributed, producing a very satisfactory product.

This preparation, strictly speaking, is not an emulsion, but conforms to the definition for a true mixture. (See Mixtures)

The emulsion is generally white, but later, it sometimes turns pink. This is probably due to oxidation of some constituent in the drug. It is sometimes difficult to get rid of the odor in the mortar; the use of a little lye solution, followed by soap and water, or pour in a little alcohol and burn it will assist in cleaning the mortar.

Average dose -- 15 cc.

EMULSUM OLEI TEREBINTHINAE USP Emulsion of Oil of Turpentine.
(Emuls. Ol. Tereb.)

Rectified Oil of Turpentine.	15 cc.
Acacia, in a very fine powder.	5 Gm.
Distilled Water, a sufficient quantity, To make.	100 cc.

Place the powdered acacia in a dry bottle, add the oil of turpentine, mix thoroughly, add exactly 10 cc. of distilled water, and agitate briskly until an emulsion forms. Then add sufficient distilled water to make the product measure 100 cc. and mix thoroughly.

The USP process is that known for many years as Forbes' Method for Emulsions. If the bottle is dry, the emulsion is quickly formed. This emulsion is very thin and the emulsified oil soon rises to the top. 15 grams of acacia, some almond oil and some syrup will make a thicker emulsion.

Uses--A carminative in flatulent colic, also a stimulant expectorant in bronchitis. The rectified oil only should be used for internal administration as the crude oil frequently contains rosin.

Average dose-- 2 cc.

EMULSUM OLEI MORRHUAE USP Emulsion of Cod Liver Oil
(Emuls. Ol. Morrh.)

Cod Liver Oil.	500 cc.
Acacia, in very fine powder.	125 Gm.
Syrup.	100 cc.
Methyl Salicylate.	4 cc.
Distilled Water, a sufficient quantity, To make.	1000 cc.

Quickly and thoroughly mix the acacia with the cod liver oil in a dry mortar or other suitable vessel, then add at once 250 cc. of distilled water and complete the emulsification by trituration or by the aid of a suitable mechanical device. When a thick, white, homogeneous emulsion is obtained, add the methyl salicylate and the syrup with sufficient distilled water to make the product measure 1000 cc. and mix thoroughly.

Note--In preparing Emulsion of Cod Liver Oil other methods of emulsification may be used and the quantity of acacia may be reduced or replaced by agar, gelatin, tragacanth, or mixtures of any of these, provided the resulting Emulsion is similar in viscosity and appearance to that made by the above formula.

The methyl salicylate may be replaced with not more than 1 per cent of any other flavoring substance or by any mixture of flavoring substances recognized in the Pharmacopoeia.

This Emulsion is intended to be prepared just before being dispensed. If it is to be kept for any length of time, 70 cc. of alcohol should be added, replacing a corresponding volume of distilled water. The alcohol should be added last and in small portions, shaking after each addition.

Cod Liver Oil Emulsion is preferably prepared extemporaneously by the technician, since it is known that the vitamin A potency of Cod Liver Oil is destroyed by oxidation and this is intensified by the emulsification process and by the presence of some emulsifying agents, notably acacia. It is claimed, however, that anti-oxidants can be added to prevent the loss of vitamin A. Carbon dioxide is sometimes passed through the emulsion to remove air and retard oxidation.

Uses--This is simply a more palatable form of cod liver oil and possesses identical therapeutic action, (nutrient and alterative).

Average dose--(Administer three times daily).

Infants: 8 cc.

Adults: 15 cc.

EMULSUM PETROLATI LIQUIDI USP Emulsion of Liquid Petrolatum
(Emuls. Petrolat. Liq.--Mineral Oil Emulsion)

Liquid Petrolatum	500 cc.
Acacia, in a very fine powder.	125 Gm.
Syrup.	100 cc.
Vanillin.	0.04 Gm.
Alcohol.	60 cc.
Distilled Water, a sufficient quantity, To make.	<u>1000 cc.</u>

Mix the liquid petrolatum with the powdered acacia in a dry mortar, add 250 cc. of distilled water all at once, and emulsify the mixture. Then add, in divided portions and triturating after each addition, a mixture of the syrup, 50 cc. of distilled water and the vanillin, dissolved in the alcohol. Finally add sufficient distilled water to make the product measure 1000 cc.

Note--In preparing Emulsion of Liquid Petrolatum other methods of emulsification may be used and the quantity of acacia may be reduced or it may be replaced by agar, gelatin, tragacanth or mixtures of any of these emulsifying agents, provided the resulting emulsion is similar in viscosity and appearance to the emulsion made by the formula given.

Heavy Liquid Petrolatum should be used in preparing this emulsion as that variety is preferable for internal administration as is less likely to cause "leakage"

As a rule lemon should not be used as a flavor for preparations to be kept for some time, because it acquires a turpentine-like taste. In recent years emulsions of heavy liquid petrolatum, particularly in combination with agar or phenolphthalein, have come into favor. The amount of agar which can be put into an emulsion is of no use therapeutically; a very little agar has the property of solidifying a large amount of liquid. A few grains of agar is all that can be put into a pint of emulsion.

Uses--A palatable form of Liquid Petrolatum for administration as an intestinal lubricant.

Average dose-- 30 cc.

EMULSIONS

Definition:

What are emulsifying agents?

What are the functions of emulsifying agents?

What is meant by a stratified emulsion?

How does this differ from a "cracked" emulsion?

How do "oil in water" and "water in oil" emulsions differ and what accounts for the type?

How should emulsions as a class be stored and dispensed?

Differentiate between acacia and tragacanth as emulsifying agents

EMULSUM ASAFOETIDAE.

O.E.T. U.S.P. or N.F.

Syn.

Prepare 120 cc.

Show Calculations.

Formula:

Why should the powdered asafetida which is on the Supply Table not be substituted for the tears of asafetida?

What is the emulsifying agent in this preparation? .

How may the mortar be cleaned which is used in preparation?

Use:

Dose:

EMULSUM OLEI TERBINTHINAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 100 cc.

Show Calculations:

Formula:

Why must rectified oil of turpentine be used?

Why is this emulsion directed to be made in a bottle, rather than a mortar?

Uses and doses:

Description and physical properties.

EMULSUM OLEI MORRHUAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 120 cc.

Show Calculations.

Formula:

Give U.S.P. XI "note" under this emulsion.

List several flavors with quantities which might be used in place of the methyl salicylate.

How may the development of the "fishy" taste in this emulsion be retarded?

Uses.

Doses.

Physical Properties.

EMULSUM PETROLATI LIQUIDI

O.E.T. U.S.P. or N.F.
Syn. Abbr.

Prepare 120 cc.

Show Calculations:

Formula:

Give the U.S.P. XI "note" under this emulsion.

Why must water be added slowly to the primary emulsion when diluting it?

Uses and doses.

Description and physical properties.

MIXTURES

Mixtures, in a properly restricted sense, are aqueous liquid preparations intended for internal use, which contain suspended insoluble solid substances. The main object in introducing this class into the Pharmacopoeia was to secure uniformity in the formulas of certain well-known and largely used preparations. They are not permanent, as a rule, and it is not wise to keep them on hand for any considerable length of time. Since they contain insoluble matter, they must be dispensed with a "Shake Well!" label. They differ from emulsions in containing no fat; from liniments, in being used internally.

MISTURA CRETAE USP Chalk Mixture (Mist. Crét.)

Compound Chalk Powder.	20 Gm.
Cinnamon Water.	40 cc.
Distilled Water, a sufficient quantity,	
To make.	100 cc.

Gradually add the cinnamon water and about 20 cc. of distilled water to the compound chalk powder in a mortar, triturating until the mixture is uniform; transfer this to a graduated vessel, rinse the mortar with enough distilled water to make the product measure 100 cc. and mix thoroughly.

Caution--This preparation must not be dispensed unless it has been recently prepared.

This preparation formerly contained acacia, sugar, prepared chalk, cinnamon water and water. The mixture of the solids was official under the name of compound chalk powder, and is still recognized. The preparation quickly fermented and acquired a disagreeable odor and taste. The present formula makes a mixture which keeps better but the Pharmacopoeia says it must not be dispensed unless it has been recently prepared. Prepared chalk, although not as pure as calcium carbonate, is smoother, less gritty, and less crystalline. Glycerin aids suspension a little.

Uses--An antacid and mechanical protective agent in the alimentary canal. Used in diarrhea. It is frequently combined with astringents like the tinctures of kino and gambir.

Average dose--15 cc.

MISTURA OPII ET GLYCYRRHIZAE COMPOSITA USP Compound Mixture of Opium and Glycyrrhiza (Mis. Opii et Glycyrrh. Comp.--Mistura Glycyrrhizae Composita, USP X; Compound Mixture of Glycyrrhiza; Brown Mixture)

Fluidextract of Glycyrrhiza.	120 cc.
Antimony and Potassium Tartrate.	0.24 Gm.
Camphorated Tincture of Opium.	120 cc.

Spirit of Ethyl Nitrite.	30 cc.
Glycerin.	120 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Dilute the fluidextract with the glycerin and 500 cc. of distilled water, add the antimony and potassium tartrate, dissolved in 12 cc. of hot distilled water, then the other ingredients, and enough distilled water to make the product measure 1000 cc.

Alcohol content--From 9 to 11 per cent, by volume, of C_2H_5OH .

This formula in which the extract of glycyrrhiza is replaced by the fluidextract will contain little precipitate, but it is intended to be dispensed without filtering to retain its universally known classification as a mixture. In very warm weather the mixture occasionally ferments.

This is practically a solution, as inert matter from the extract with a little matter from paregoric is all that is precipitated.

Uses--An expectorant frequently used in bronchitis. Often combined with ammonium chloride.

It contains only a minute trace of opium and therefore belongs to the class of narcotics known as "exempt narcotics." The title was changed in the USP XI to emphasize to the public the fact that the product does contain opium.

Average dose. 4 cc.

MISTURA RHEI COMPOSITA NF Compound Mixture of Rhubarb (Mist. Rhei Co.--Mistura Rhei et Sodae, Mixture of Rhubarb and Soda)

Fluidextract of Rhubarb.	15 cc.
Fluidextract of Ipecac.	3 cc.
Sodium Bicarbonate.	35 Gm.
Spirit of Peppermint.	35 cc.
Glycerin.	200 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Dissolve the sodium bicarbonate in about 500 cc. of the water; add the fluidextracts, the glycerin, the spirit of peppermint, and sufficient distilled water to make the product measure 1000 cc. and mix thoroughly.

Alcohol content--From 2 to 4 per cent, by volume, of C_2H_5OH .

Sodium Bicarbonate is put in for its therapeutic effect, but also helps to prevent precipitation of resinous matter from the fluidextracts. A slight effervescence occurs, because tannic acid in the fluidextracts and hydrochloric acid in the fluidextract of ipecac liberate carbon dioxide from the carbonate.

Uses--A laxative, antacid and carminative.

Average dose-- 4 cc.

MISTOPA CRETAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc. Show Calculations:

Formula:

What precaution should be taken when dispensing this preparation?

Uses and dose.

Physical Properties.

MISTURA OPII ET GLYCYRRHIZAE COMPOSITE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 240 cc.

Show Calculations.

Formula:

Should this preparation be filtered? Why?

State the cc. of Paregoric and Gms. of Tartar Emetic per dose of mixture?

Uses and doses.

Physical Properties.

MISTURA RHEI COMPOSITA

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc. Show Calculations:

Formula:

Why does a slight effervescence occur when preparing this mixture?

Determine the amount of Fluidextract of Ipecoe per each dose of mixture?

Uses and doses:

Alcoholic content?

MAGMAS

This title has been introduced into the U.S.P. and N.F. as applying to a class of preparations closely related to mixtures. The suspended, insoluble constituents are of inorganic chemical origin and are freshly precipitated in a fine state of subdivision. It may also be said that magmas are bulky precipitates which hold a large amount of water. They are difficult to wash free from impurities, and are better washed by decantation than by filtration.

MAGMA MAGNESIAE USP Magnesia Magma (Magma Mag.--Milk of Magnesia)

Magnesia Magma is an aqueous suspension of magnesium hydroxide containing not less than 7 per cent and not more 8.5 per cent of $\text{Mg}(\text{OH})_2$ (58.34). For purposes of minimizing the action of the glass container on Magnesia Magma, 0.1 per cent of citric acid may be added.

Note--One-half cc. of a volatile oil or a blend of volatile oils, suitable for flavoring purposes may be added to each 1000 cc. of Magnesia Magma.

No formula is now included in the USP as there are various satisfactory methods of preparation and any one of these may be used if the finished product conforms in physical appearance and other characteristics to the official specifications. The former official method is given below:

Magnesium sulfate.	300 Gm.
Sodium Hydroxide.	100 Gm.
Distilled Water, a sufficient quantity,	
To make about.	1000 cc.

Dissolve the magnesium sulfate in sufficient distilled water to make 650 cc., place this in a vessel of about 5000 cc. capacity, and heat to boiling. Dissolve the sodium hydroxide in sufficient distilled water to make 1000 cc., add this slowly to the boiling solution of magnesium sulfate, and continue the boiling for thirty minutes. Transfer the mixture to a cylindrical container of not less than 5000 cc. capacity, and fill with hot distilled water. Allow to stand until separation has occurred, and remove the supernatant liquid. Wash repeatedly with hot distilled water until sulfates have practically been eliminated, as shown by testing the supernatant liquid with barium chloride T.S. Concentrate the mixture by evaporation until it contains not less than 7 per cent of magnesium hydroxide.

Distilled Water is used in this preparation because the slightest trace of iron will cause discoloration. If the available water supply is free from iron, and otherwise suitable, or if it has been heated to boiling with powdered magnesium carbonate (5 Gm. in each 1000 cc.), and then filtered, distilled water will

not be necessary.

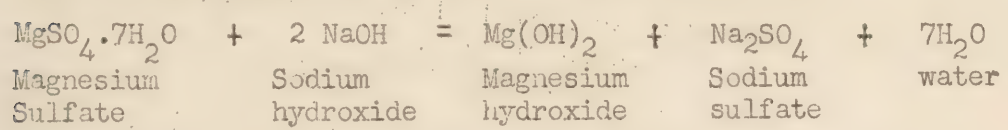
This preparation is also made on a large scale by mixing freshly calcined magnesium oxide with distilled water in proper proportion. After hydration, which is accompanied by the evolution of heat, the product is usually passed through a colloid mill equipped with a special steel rotor, to avoid contamination due to wear. A special magnesium hydroxide is now readily obtained, packed in containers which are moisture proof and air tight.

A more recent product is magnesium hydroxide powder. This forms stable suspensions with water and permits the production of the magma by merely suspending the powder in water.

If the cork stoppers are not protected by dipping them in melted paraffin, the magma soon darkens due to action on the tannin of the cork. The product should be protected against freezing, as this alters the colloidal gel, a more dense precipitate forming and a clear water stratum separating on top.

Magnesia Magma readily absorbs carbon dioxide from the air, and hence the containers must be well stoppered.

The reaction which takes place when prepared by the formula given is shown by the following equation:



Description and Physical Properties: A white, opaque, more or less viscous suspensions from which varying amounts of water usually separate on standing.

U.S.P. Preparation--Magma Ferri Hydroxidi.

Storage--It is recommended that Magnesia Magma be stored at temperatures not exceeding 35° C. It should not be permitted to freeze.

Uses--It is used as an antacid and laxative and the addition of a flavor, as suggested above, renders it very acceptable when used as an antacid mouth wash, for which purpose it is frequently used under a dentist's orders. The usual dose as an antacid is 4 cc.; as a laxative, 15 cc.

MAGMA FERRI HYDROXIDE USP Magma of Ferric Hydroxide (Magma Ferr. Hydrox.--Arsenic Antidote, Ferri Hydroxidum cum Magnesii Oxido, USP X)

Solution of Ferric Sulfate. 40 cc.
Magnesium Oxide. 10 Gm.
Distilled Water, a sufficient quantity.

Mix the solution of ferric sulfate with 125 cc. of distilled water, and keep the liquid in a large well-stoppered bottle.

Rub the magnesium oxide with cold water to a smooth, thin mixture, transfer this to a bottle capable of holding about 1000 cc., fill it with distilled water to about three-fourths of its capacity, and keep it tightly stoppered. When the preparation is needed, shake the magnesium oxide mixture until of a thin, creamy consistency, slowly add to it the diluted solution of ferric sulfate, and shake them together until a uniformly smooth mixture results.

Uses--Ferric hydroxide is produced when the mixture of magnesium oxide is added to the diluted solution of ferric tersulfate, and, as the magnesium oxide is in excess and acidity thus prevented, no harm can result from not separating the by-products of the reaction. It contains, in addition to the ferric hydroxide, magnesium sulfate and hydroxide. The alternative use of milk of magnesia to replace the magnesium oxide mixture, as suggested by the Pharmacopoeial note, is due to the difficulty experienced in keeping the magnesia-water mixture over an extended period without its solidifying. The magnesia magma exhibits no such tendency to become solid.

This preparation is used only as an antidote for arsenic poisoning, its action presumably depending upon the adsorption of arsenic by the magma. Because of the need of promptness in such emergency and as it is only efficient when freshly prepared, the technician should always keep the solutions on hand ready for extemporaneous mixture.

Average dose--120 cc.

Solution of ferric sulfate may be prepared as follows:

Ferrous Sulfate.	500 Gm.
Sulfuric Acid.	96 Gm.
Nitric Acid,	
Distilled Water, each, a sufficient quantity,	
To make.	1000 Gm.

Add the sulfuric acid to about 250 cc. of distilled water in a tared, capacious porcelain dish, heat the mixture nearly to 100° C., then add 56 Gm. of nitric acid, and mix well. Divide the ferrous sulfate, coarsely powdered, into four approximately equal portions, and add these portions one at a time to the hot liquid, stirring after each addition until effervescence ceases. When all of the ferrous sulfate is dissolved, if the solution has acquired a black color, add nitric acid, a few drops at a time, heating and stirring until red fumes cease to be evolved, and the solution assumes a clear reddish brown color; then boil the liquid until it is free from nitric acid, as indicated by the test given below. During the heating add distilled water from time to time to maintain about the original volume. Lastly, add enough distilled water to make the product weigh 1000 Gm. Filter, if necessary.

This solution is a reddish-brown liquid, almost odorless, having an acid, strongly styptic taste, and an acid reaction to litmus paper. To test this solution for nitric acid or nitrates the following procedure is given: Dilute 2 cc. of Solution of

Ferric Sulfate with 10 cc. of distilled water, heat to boiling, and pour into a mixture of 10 cc. of distilled water and 10 cc. of ammonia T.S. Filter while hot, and wash the filter with hot distilled water until the filtrate measures 30 cc. Mix the filtrate well and to 5 cc. of it add 2 drops of indigo carmine T.S. and 10 cc. of sulfuric acid; the blue color should not disappear in one minute.

MAGMAS

Definition:

How do magmas differ from mixtures?

Define colloid..

Explain the principle of a syphon.

MAGMA MAGNESIAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 120 cc.

Show Calculations:

Formula: (U.S.P. X)

Why was the formula and method of preparation deleted from the U.S.P. XI?

Why must distilled water be used throughout this process?

Why should the washing water be removed by decantation or syphoning instead of filtering?

Explain the permitted addition of citric acid to the magma.

Uses and doses.

Storage.

Description and physical properties.

Why should cork stoppers be protected?

MAGMA FERRI HYDROXIDI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

U.S.P. X Title. _____

Prepare 1 dose:

Formula:

Give the reactions involved.

Why should the antidote be prepared only when needed and not be kept prepared?

Give the "note" under this preparation.

Uses and doses.

Storage.

Description and Physical Properties.

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PHARMACY - GALENICAL
For Pharmacy Technicians
Vol. II
Part II

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FOR THE USE OF STUDENTS.

GALENICAL PHARMACY

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LOTIONS

Lotions are fluid preparations, usually containing suspended insoluble matter and applied externally. They differ from mixtures in being designed for external use and from liniments in being aqueous, rather than oleaginous or alcoholic. No lotions are recognized in the pharmacopoeia but only in the N. F. A "shake well" label should be used with each. Suspending agents are not used in N. F. lotions. They should not be filtered.

In many commercial face lotions a small amount of tragacanth (1 per cent) or mucilage of quince seed is used. Tragacanth contains two gums; one is soluble in water, and the other is not soluble, but swells in water. Enough of tragacanth should be used to keep the insoluble portion suspended, but not enough to make it too thick. The amount of glycerin should not be so much as to leave the face and hands sticky, but soft and pliable, although enough to prevent the gum from becoming hard and disagreeable. If quince seed is used, care should be taken not to use that which has been eaten by bugs, as little particles of the dark coat are liable to get into the finished product and more difficult to remove.

LOTIO CALAMINAE NF Calamine Lotion

Prepared Calamine.	80 Gm.
Zinc Oxide.	80 Gm.
Glycerin.	20 cc.
Solution of Calcium Hydroxide, a sufficient quantity,	
To make.	<u>1000 cc.</u>

Mix the powders intimately with the glycerin and about 100 cc. of solution of calcium hydroxide to a smooth, uniform paste. Gradually add, with agitation after each addition, sufficient of the solution of calcium hydroxide to make the product measure 1000 cc.

Note--Shake the lotion thoroughly before dispensing.

Calamine is a native zinc carbonate containing some zinc silicate, calcined at a moderate temperature; or calcined zinc carbonate, containing a small amount of ferric oxide. The commercial calamine is frequently the latter and sometimes the ferric oxide is not as thoroughly mixed with the zinc as it should be. Calamine varies in the volume of a given weight, which may cause a difference in the appearance of the lotion. The pinkish color is due to the presence of iron. In preparation of Calamine, the native zinc oxide is calcined in covered earthen crucibles, then powdered and freed from gritty particles by elutriation.

N. F. Preparation--Lotio Calaminae Phenolata. Phenolated Calamine Lotion is prepared by adding 1 per cent of liquefied phenol to Calamine Lotion.

Uses--Employed in skin diseases.

LOTIO FLAVA NF Yellow Lotion
(Lot. Flav.--Yellow Wash; Aqua Phagedaenica Flava)

Mercury Bichloride.	3 Gm.
Distilled Water.	35 cc.
Solution of Calcium Hydroxide, a sufficient quantity,	
To make.	1000 cc.

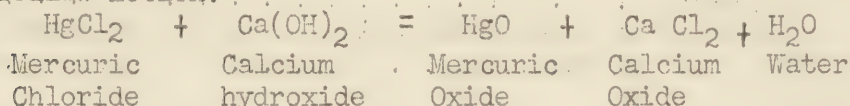
Dissolve the mercury bichloride in the boiling water, and add the solution gradually, with constant agitation, to sufficient of the solution of calcium hydroxide to make the product measure 1000 cc.

Note--Shake the Lotion thoroughly before dispensing. This Lotion should be freshly prepared, as the precipitate has a tendency to coagulate into larger particles on standing for some time.

Uses--Applied as a stimulant antiseptic application to syphilitic sores, and in some forms of eczema.

The solution of mercuric chloride is poured into the lime water, not the lime water into the mercuric chloride, so as to have an excess of calcium hydroxide. If the lime water is weak or is not in excess, a red-brown basic chloride of mercury is formed instead of the yellow oxide.

Following is the formula of the reaction in preparing Yellow Lotion:



LOTIO NIGRA NF Black Lotion
(Lot. Nig.--Black Wash; Aqua Phagedaenica Nigra)

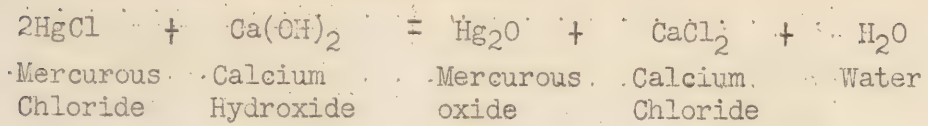
Mild Mercurous Chloride.	9 Gm.
Acacia, in fine powder.	1 Gm.
Water.	100 cc.
Solution of Calcium Hydroxide, a sufficient quantity,	
To make.	1000 cc.

Triturate the mild mercurous chloride and acacia in a mortar. Gradually add the water, mixing thoroughly, and then add the mixture slowly, with constant agitation, to sufficient of solution of calcium hydroxide to make 1000 cc.

Note--Shake the Lotion thoroughly before dispensing. This Lotion should be freshly prepared, as the precipitate has a tendency to coagulate into larger particles on standing for some time.

Uses--Similar to yellow lotion, but is not so active a stimulant.

The following reaction takes place, the black precipitate being mercurous oxide:



LOTIONS

Definition:

Give: Titles- Synonyms and uses of N. F. Lotions.

In what respects do lotions and mixtures differ?

LOTIO CALAMINAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc.

Show Calculations:

Formula:

Method of preparation.

What should be noted when dispensing?

Description.

LOTIO FLAVA

O.E.T. U.S.P. or N. F.

Syn. Abbr.

Prepare 120 cc.

Show Calculations.

Formula:

Method of Preparation.

Why is the solution of mercuric chloride poured into the lime water and not the lime water into the mercury solution in making this preparation?

LOTIO NIGRA

O.E.T. U.S.P. or N. F.

Syn. Abbr.

Prepare 120 cc.

Show Calculations.

Formula.

Method of preparation.

Description.

Uses.

GLYCERITES

GLYCERITES are mixtures of medicinal substances with glycerin. Glycerin is a valuable solvent, and one of the principal advantages of the glycerites is that they afford a rapid and simple method of making aqueous solutions of substances which are not otherwise easily soluble. The solutions of phenol, tannic acid, tar, etc. in glycerin are permanent preparations, and they can be made very concentrated if necessary; the ease with which they can be diluted with water or alcohol, without precipitation, renders such glycerites especially useful at the prescription counter. Glycerin is very hygroscopic, and all these preparations absorb moisture on exposure to air but no decomposition of official preparations takes place except in case of boroglycerin. They have the disadvantage of being smeary like their vehicles. Most of them are solutions, but one of those official (glycerite of starch) is a semisolid mass. Besides being permanent, these preparations also have the advantage of being emollient.

GLYCERITUM ACIDI TANNICI USP Glycerite of Tannic Acid (Glycer. Acid. Tan.--Glycerite of Tannin)

Tannic Acid.	20 Gm.
Sodium Citrate.	1 Gm.
Glycerin.	79 Gm.
To make.	100 Gm.

Rub the tannic acid and sodium citrate in a porcelain dish with about half of the glycerin until a smooth mixture is produced, then add the remainder of the glycerin, and mix well. Heat the mixture on a sand bath to a temperature between 115° and 120° C. with occasional stirring, until solution is complete.

The sodium citrate is added to prevent the darkening which frequently occurs because of minute amounts of iron in the glycerin.

Heat is used to hasten solution and to render the glycerin more fluid. Putting the tannic acid and sodium citrate into a bag and dissolving by circulatory displacement is simply an easy way of effecting solution and avoids the necessity of straining later. Iron utensils should be avoided, because tannic acid with iron makes the dark tannate of iron. The color differs in different samples on account of the variation in the tannic acid. This glycerite is a convenient solution for dispensing or for diluting with water.

Uses--An astringent, especially useful as a local application in sore throat and in sore mouth, due to stomatitis. It is also used to harden nipples to prevent soreness during nursing, and as a general astringent.

Average dose--2.5 cc.

GLYCERITUM AMYLI USP Glycerite of Starch
(Glycer. Amyl.--"Plasma")

Starch.....	10 Gm.
Distilled Water.....	20 cc.
Glycerin.....	70 cc.
To make about.....	<u>100 Gm.</u>

Rub the starch with the distilled water in a porcelain dish until a smooth mixture is produced, then add the glycerin, and mix well. Heat the mixture on a sand bath to a temperature between 140° and 144° C., with constant but gently stirring until a translucent, jelly-like mass results, and then strain through muslin. Transfer the product to suitable containers provided with close-fitting covers.

Starch is triturated with water to break up all lumps. The glycerin should not be too hot when the starch and water are added, because if it is, the product will be lumpy and not homogeneous. A heat higher than that of a water bath is necessary to dissolve the granules. If a thermometer is used, it must be remembered that the mass is very thick so that it retards the passing of heat to the bulb of the thermometer and the starch may burn, although the thermometer shows a temperature below 144° C. The glycerite should be translucent and not dark colored. A sand bath is better than a naked flame, because there is less danger of burning.

Uses--Used as a substitute for fatty ointment vehicles, also as a pill excipient, and as a basis for enemas.

GLYCERITUM BOROGLYCERINI USP Glycerite of Boroglycerin
(Glycer. Boroglyc.--Glycerite of Glyceryl Borate, 50 per cent Boroglycerin)

Boric Acid, in fine powder.....	310 Gm.
Glycerin, a sufficient quantity,	
To make.....	<u>1000 Gm.</u>

Heat 460 Gm. of glycerin in a tared porcelain dish on a sand bath to a temperature between 140° and 150° C. and add the boric acid in portions, constantly stirring. When all the boric acid is added and dissolved, maintain the liquid at the same temperature, frequently stirring it and breaking up the film which forms on the surface, until the mixture has been reduced to a weight of 500 Gm.; then add 500 Gm. of glycerin, mix thoroughly, and immediately transfer the product to suitable containers.

When glycerin and boric acid are heated together in the proportion given in the formula, water is given off, and a new compound is formed as shown by the following equation:



As the reaction proceeds, the product thickens, requiring frequent stirring to break up the film which forms, and finally produces a hard, partially transparent, and very hygroscopic mass. This substance is called "boroglycerin," and when dissolved in an equal weight of glycerin constitutes the official Glycerite of Boroglycerin. Care must be observed throughout the operation to avoid an excess of heat which causes a yellowish or brownish color.

If glycerin which has absorbed water is used in making this preparation, the mixture of glycerin and acid is reduced to the proper weight before the chemical action is finished, and when the preparation becomes cold, boric acid often crystallizes out. Since boroglycerin is a hard, tough solid when cold, it should be dissolved in the remaining glycerin while still warm. This glycerite should be put into a dry, well-stoppered container, because water causes the reverse reaction to take place, forming glycerin and boric acid. If it is desired to dilute it, glycerin, not water, should be used.

NF Preparation--Suppositoria Boroglycerini.

Storage--Preserve Glycerite of Boroglycerin in well closed containers.

Uses--A mild antiseptic, offering boric acid in soluble form. It is often used in washing out the bladder. If water is added in proportions larger than 1 part of glycerite to 18 parts of water, boric acid will be reprecipitated, so that if weaker solutions than 1 to 18 are required, glycerin should be used as the diluent.

GLYCERITUM PHENOLIS NF Glycerite of Phenol

(Glycer. Phenol.--Glycerite of Carbolic Acid)

Liquefied Phenol.	20 cc.
Sodium Citrate.	1 Gm.
Distilled Water.	1 cc.
Glycerin.	79 cc.
To make about.	100 cc.

Dissolve the sodium citrate in the hot distilled water, and incorporate this solution with the mixture of glycerin and liquefied phenol.

This preparation mixes with any proportion of water without separation of phenol. Liquefied phenol contains 10 per cent of water and not less than 88 per cent of phenol, so that the glycerite contains approximately 18 per cent of phenol. Glycerin sometimes contains traces of iron which might cause discoloration and sodium citrate is put in to prevent this.

Uses--For preparing antiseptic dilutions of phenol. It is used also as an addition to gargles and mouth washes.

Average dose--0.3 cc. One average metric dose contains 0.06 cc. of Liquefied Phenol.

Definition:

In reference to solubility, what are the advantages of glycerites?

How should preparations in this class be stored?

GLYCERITUM ACIDI TANNICI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 30 Gm.

Show Calculations.

Formula:

What is the purpose of the sodium citrate?

Uses.

Description and physical properties.

GLYCERITUM BOROGLYCERIN

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 50 Gm.

Show Calculations.

Formula:

Show by equation, the reactions involved.

Why must the glycerin be heated to 140° C.?

Why is the mixture heated until reduced to 50 Gm.?

Uses.

Description and physical properties.

GLYCERITUM PHENOLIS

O.E.T. U.S.P. or N.F.

Prepare 60 cc. Show Calculations.

Formula:

Why is the sodium citrate included in this preparation?

Why is this such an excellent stock preparation?

Use:

Dose:

GLYCERITUM AMYLI.

O.E.T. U.S.P. or N.F.

Syn. Show Calculations.

Prepare 30 Gms.

Formula:

Why should the starch be triturated with cold water first?

Why heat between 115° and 120° C?

Use:

Dose:

SPIRITS

SPIRITS, from a pharmaceutical point of view, are alcoholic solutions of volatile substances. They differ from waters only in the solvent employed. For this reason a number of spirits are made from substances which are also used in the manufacture of waters. Practically, all the volatile oils represented in the list of aromatic waters are found in alcoholic solutions among the spirits. Spirits are popularly known as essences. Like the medicated waters, the active ingredient may be solid, liquid, or gaseous. None are made by percolation, but there are four different methods represented in the preparation of this official group: 1. By simple solution. 2. By solution with maceration. 3. By chemical reaction. 4. By distillation.

1. By Simple Solution--This is the method by which the majority of spirits are prepared; the official preparations of this class are merely solutions of volatile oils in alcohol of appropriate strength. No especial skill is required to make these, but a great deal of conscientious care must be used in the selection of the volatile oils, that they be of superior quality, and in proper condition. Filtration is sometimes necessary to obtain a product of the desirable brilliancy.

2. By Solution with Maceration--This method is employed when it is desirable to introduce the coloring matter of the drug into the preparation. This has been done in order to bestow individuality, and in deference to popular demand for colored preparations.

3. By Chemical Reaction--The U.S.P. XI has omitted a method for the preparation of Spirit of Ethyl Nitrite but this and several other official spirits embody chemical reactions in their preparation.

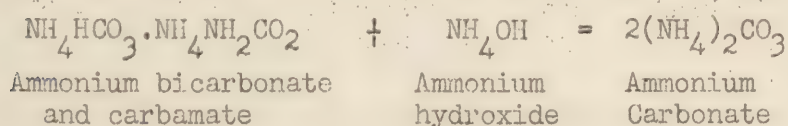
4. By Distillation--This method of making spirits is the oldest and in many respects the best in use. When the desirable volatile principles which are present in the finished preparation can be vaporized at the temperature of boiling alcohol or diluted alcohol, distillation is preferred. Two spirits of the U.S.P. are made by distillation. They are whisky and brandy.

SPIRITUS AMMONIAE AROMATICUS USP Aromatic Spirit of Ammonia (Sp. Ammon. Arom.)

Ammonium Carbonate, in translucent pieces.	34 Gm.
Ammonia Water.	90 cc.
Oil of Lemon.10 cc.
Oil of Lavender.	1 cc.
Oil of Myristica.	1 cc.
Alcohol.700 cc.
Distilled Water, a sufficient quantity,	
To make.	1.000 cc.

Dissolve the ammonium carbonate in the ammonia water and 140 cc. of distilled water by gentle agitation, and allow the solution to stand for twelve hours. Dissolve the oils in the alcohol, contained in 1000 cc. volumetric flask or cylinder, gradually add the ammonium carbonate solution, and enough distilled water to make the product measure 1000 cc. Set aside in a cool place for twenty-four hours, occasionally agitating the mixture, and then filter, using a covered funnel.

The ammonium carbonate in this preparation must be in translucent pieces. The soft, chalky variety is chiefly ammonium bicarbonate, a deteriorated product. Commercial ammonium carbonate is a mixture of ammonium bicarbonate and ammonium carbamate, the latter being soluble in alcohol but not the former. "Translucent pieces" should be used so as to get the correct amount, because if they are opaque they have lost some ammonia and carbon dioxide, leaving a larger proportion of bicarbonate. Ammonia water converts the commercial salt into the normal carbonate.



The mixture of ammonia water and carbonate is allowed to stand twelve hours for this reaction to take place. Later the whole mixture is allowed to stand twenty-four hours so that any excess of oils or ammonium bicarbonate may separate. This spirit slowly darkens as the ammonia acts on the oils and aldehyde in the alcohol.

History—This first found an official place in the London Pharmacopoeia of 1721 under the name Spiritus Salis Volatilis Oleosus. The present name was first adopted in the P. L. of 1809. The formula and process have changed repeatedly during the several centuries in which the preparation has been used.

NF Preparations--Liquor Sodae et Menthae; Tinctura Guaiaci Ammoniata; Tinctura Valerianae Ammoniata.

Uses--For hyperacidity of the stomach, especially when accompanied by nausea and sick headache. Also employed for faintness.

Average dose--2 cc.

APIRITUS AURANTII COMPOSITUS USP Compound Spirit of Orange
(Sp. Auran. Col.)

Compound Spirit of Orange contains, in each 100 cc., not less than 25 cc. and not more than 30 cc. of the mixed oils.

Oil of Orange.	200 cc.
Oil of Lemon.	50 cc.
Oil of Coriander.	20 cc.
Oil of Anise.	5 cc.
Alcohol, a sufficient quantity,	
To make.	1000 cc.

Mix the oil with sufficient alcohol to make the product measure 1000 cc.

Alcohol content--From 65 to 75 per cent, by volume, of C_2H_5OH .

U.S.P. Preparation--Elixir Aromaticum.

N. F. Preparations--Elixir Aminopyrinae; Elixir Buchu; Juniperi et Potassii Acetatis; Elixir Calcii Lactophosphatis; Elixir Carnis et Ferri; Elixir Ferri, Quininae et Strychninae; Elixir Hydrangeae et Lithii; Elixir Iso-alcoholicum; Elixir Phosphori; Elixir Sabal et Santali Compositus; Emulsions.

Storage--Preserve Compound Spirit of Orange in well-closed containers and protected from light.

Uses--A flavor for elixirs. An alcoholic solution of this kind permits the uniform introduction of small proportions of oils and also preserves such oils as orange and lemon from rapid oxidation.

SPIRITUS CAMPHORAE USP Spirit of Camphor
(Sp. Camph.--Tinctura Camphorae; Tincture of Camphor)

Spirit of Camphor is an alcoholic solution containing in each 100 cc., not less than 9.5 Gm. and not more than 10.5 Gm. of camphor, at 25° C.

Camphor.	100 Gm.
Alcohol, a sufficient quantity,	
To make.	1000 cc.

Dissolve the camphor in about 800 cc. of alcohol and add enough additional alcohol to make the product measure 1000 cc. Filter if necessary.

Dissolving 100 grams of camphor in alcohol increases the volume just about 100 cc., which is more than solids generally increase the volume when dissolved. Synthetic camphor differs from natural camphor in that it does not rotate polarized light.

Alcohol content--From 80 to 87 per cent, by volume, of C_2H_5OH .

Uses--Used as a sedative and antispasmodic in diarrhea, and also in hysteria, headache, and other forms of nervous excitement. A stimulant in small doses.

Average dose--1 cc.

SPIRITUS CHLOROFORMI USP Spirit of Chloroform
(Sp. Chlorof.)

Spirit of Chloroform contains, in each 100 cc., not less than 8.5 Gm. and not more than 9.25 Gm. of $CHCl_3$ at 25° C.

Chloroform. 60 cc.
Alcohol, a sufficient quantity,
To make. 1000 cc.
Mix the chloroform with sufficient alcohol to make the
product measure 1000 cc.

Alcohol content--From 85 to 91 per cent, by volume, of
 C_2H_5OH .
Storage--Preserve Spirit of Chloroform in well-closed
containers and protected from light.
Uses--A sedative in cough mixtures and in flatulence.
Average dose--2 cc.

SPIRITUS CINNAMOMI USP Spirit of Cinnamon
(Sp. Cinnan.)

Spirit of Cinnamon contains, in each 100 cc., not less
than 9 cc. and not more than 11 cc. of oil of cinnamon.

Oil of Cinnamon. 100 cc.
Alcohol, a sufficient quantity,
To make. 1000 cc.
Mix the oil with sufficient alcohol to make the pro-
duct measure 1000 cc.

Alcohol content--From 80 to 87 per cent, by volume, of
 C_2H_5OH .
N. F. Preparations--Syrupus Ipecacuanhae et Opii,
Syrupus Reel.
Uses--A pleasantly flavored cordial.
Average dose--1 cc.

SPIRITUS MENTHAE PIPERITAE USP Spirit of Peppermint
(Sp. Menth. Pip.--Essence of Peppermint)

Spirit of Peppermint contains, in each 100 cc., not
less than 9 cc. and not more than 11 cc. of oil of peppermint.

Oil of Peppermint. 100 cc.
Peppermint, in coarse powder. 10 Gm.
Alcohol, a sufficient quantity,
To make. 1000 cc.

Macerate the peppermint leaves, freed as much as possi-
ble from stems, and coarsely powdered, during one hour in 500 cc.
of distilled water, and then strongly express them. Add the moist,
macerated leaves to 900 cc. of alcohol, and allow the mixture to
stand during six hours with frequent agitation. Filter, and to
the filtrate add the oil and sufficient alcohol to make the pro-
duct measure 1000 cc.

Peppermint herb is used to give the spirit a green
color. If the herb is first washed with water, some yellow color-
ing matter is removed and a finer green is given the preparation.

Alcohol content--From 79 to 85 per cent, by volume, of C_2H_5OH .

N. F. Preparation--Elixir Rhei Alkalinum, Mistura Rhei Composita.

Storage--Preserve Spirit of Peppermint in well-closed containers and protected from light.

Uses--A valuable carminative and gastric stimulant in flatulence, and nausea. The oil is usually employed in flavoring.

Average dose-- 1 cc.

Definition:

Give briefly three general methods for preparing spirits.

What are the common sources of alcohol?

Outline one method by which alcohol is made.

Give the synonyms and common trade names for ethyl alcohol.

Give description and physical properties for alcohol.

As a group, how should spirits be stored?

SPIRITUS AMMONIA AROMATICUS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirements:

Prepare 60 cc.

Show Calculations.

Formula:

What are translucent pieces of ammonium carbonate specified? .

Why must the ammonium carbonate solution stand for 12 hours?

Why must the final mixture stand for 24 hours before filtering?

In mixing this aqueous and alcoholic solutions, why must the aqueous solution be added to the alcoholic?

SPIRITUS AMMONIA AROMATICUS
(continued)

Give the definition for ammonium carbonate.

Show by equation the effect of treating ammonium carbonate with ammonia water.

Why does this preparation gradually change color?

Uses and dose.

Storage.

Physical Properties, and description.

SPIRITUS AURANTII COMPOSITUS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 60 cc. Show calculations.

Formula:

Use.

Description.

SPIRIT CAMPHORAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 60 cc.

Show Calculations:

Formula:

Alcoholic content.

Uses and doses.

Storage.

Description and physical properties.

From what two sources are camphor obtained?

SPIRITUS MENTHAE PIPERITAE

C.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 60 cc.

Show Calculations.

Formula:

Why are leaves first macerated in water?

What gives the color in this preparation?

Uses and doses.

Storage.

Description and physical properties.

SPIRITUS CHLOROFORMI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 60 cc. Show Calculations.

Formula:

Uses.

Storage.

SPIRITUS CINNAMOMI

O.E.T. U.S.P.

Syn. Abbr.

Prepare 60 cc. Show Calculations.

Formula:

Uses.

Storage.

ELIXIRS

ELIXIRS are hydro-alcoholic solutions of medicinal substances containing sucrose (sugar). Therefore, it can be seen that there is a slight analogy between them and syrups. In the latter, however, there is much more sucrose (sugar). Also, it may be said that Elixirs are aromatic, sweetened, spiritous preparations, frequently used as flavors and adjuvants in prescriptions and sometimes containing active medicinal substances.

Although they are largely employed throughout the United States, only two are official in the Pharmacopoeia. These are intended as vehicles for the administration of active remedies in small doses. The National Formulary, however, has recognized a large number of preparations of this class; in the group are seven intended for use as vehicles or adjuvants, and the remainder are medicated. Elixirs, when dispensed, should always be brilliantly clear, filtration through purified talc, or preferably through purified siliceous earth, being resorted to, if necessary. The utmost care should be taken in the selection of the flavoring ingredients. Especially is this necessary with volatile oils, and only those which are of excellent quality and entirely free from evidences of deterioration should be employed.

The percentage of alcohol varies from 5 to 25 per cent by volume with a few exceptions below and above these figures. Age frequently improves them, for time enables the alcohol and aromatics to blend, making a smoother, more pleasant preparation. The tendency has been to reduce the alcohol strength as far as possible and experiments have shown that elixirs will keep with comparatively little alcohol. It is generally advisable to let the preparation stand for some hours before filtering as this makes filtration easier and the filtrate usually comes through clear. Elixirs should be kept out of the light and at a uniform temperature.

ELIXIR AROMATICUM USP Aromatic Elixir (Elix. Arom.--Simple Elixir)

Compound Spirit of Orange.	12 cc.
Syrup.	375 cc.
Purified Talc.	30 Gm.
Alcohol,	
Distilled Water, each, a sufficient quantity,	
To make.	1000 cc.

To the compound spirit of orange add enough alcohol to make 250 cc. To this solution add the syrup in several portions, agitating after each addition, and afterwards add, in the same manner, a sufficient quantity of distilled water to make the product measure 1000 cc. Mix the purified talc intimately with the liquid, and filter through a wetted filter with alcohol, returning the first portions of the filtrate until a clear liquid is obtained.

The compound spirit is used to insure a uniform proportion of the several oils (i.e., orange, lemon, coriander, and anise) in every lot of the elixir. The alcoholic solution also preserves the delicate flavor of the orange and lemon for a considerable time.

Simple elixir is often difficult to filter clear and more talc than the amount directed is sometimes necessary. Terpeneless oils of orange and lemon in proper proportions are occasionally used, but they do not give as fine a flavor as the natural oils. They are more soluble and do not give the trouble in filtering.

Alcohol content--From 22 to 24 per cent, by volume, of C_2H_5OH .

U.S.P. Preparation--Elixir Glycyrrhizae.

N.F. Preparations--Elixir Aromaticum Rubrum; also in many medicated elixirs; Liquor Ferri et Ammonii Acetatis.

Uses--A pleasantly flavored vehicle, employed in the preparation of many other elixirs. The chief objection to its extensive use is the high alcohol content (about 22 per cent) which at times counteracts the effect of other medicines. The N. F. offers several vehicle elixirs of low alcoholic strength, among them, being the compound elixir of almond (about 5 per cent alcohol), aqueous elixir (non-alcoholic), and the compound elixirs of cardamom and vanillin (both with about 10 per cent alcohol). Aromatic elixir should only be used as a vehicle when specifically required as a vehicle for preparations of alcoholic strength of 20 to 25 per cent. A vehicle for preparations of greater or lesser strengths, refer to Iso-Alcoholic Elixir, this section.

Aromatic Elixir (Modified Method)

Compound Spirit of Orange.	12 cc.
Alcohol.	240 cc.
Distilled Water.	590 cc.
Purified Talc.	30 Gm.
Sucrose.	320 Gm.

To make. 1000 cc.

Triturate the compound spirit of orange with the talc and add the alcohol. Add the distilled water to the alcoholic mixture in divided portions, agitating after each addition. Set aside for twelve hours in well stoppered container and filter through wetted filter (with alcohol) until clear. Add the sucrose to the clear solution and dissolve by agitation.

This modified method of preparing aromatic elixir will prevent prolonged filtration and the possibility of loss of alcohol by evaporation.

The formula recommended has been calculated and adjusted to give a satisfactory preparation for all practical applications. The following formula is a mathematical calculation from the U. S. P. formula yet will result in a shortage of approximately 45 to 55 cc. in the finished product, therefore additional water was added to the recommended formula. The following is the mathe-

matical calculation from the U.S.P. formula: Compound Spirit of Orange, 12 cc., Sucrose, 318.75 Gm., Alcohol, 238 cc., Distilled water, 548 cc., Purified Talc, 30 Gm.

ELIXIR BROMIDORUM TRIUM. NF Elixir of Three Bromides
(Elix. Brom. Tri.--Elixir Trium Bromidorum)

Ammonium Bromide.	80 Gm.
Potassium Bromide.	80 Gm.
Sodium Bromide.	80 Gm.
Solution of Amaranth.	3 cc.
Compound Elixir of Almond, a sufficient quantity,	
To make.	1000 cc.

Dissolve the bromides in 800 cc. of compound elixir of almond, add the solution of amaranth and sufficient compound elixir of almond to make the product measure 1000 cc.; then filter until the product is clear.

Alcohol content--From 3 to 5 per cent, by volume, of C_2H_5OH .
Uses--A nerve sedative.
Average dose--4 cc.
One average dose contains about 0.32 Gm. each of Ammonium Bromide, Potassium Bromide, and Sodium Bromide.

ELIXIR FERRI, QUININAE ET STRYCHNINAE NF Elixir of Iron, Quinine and Strychnine
(Elix. Ferr. Quin. et Strych.--Elixir I. Q. & S.; Elixir Triplex)

Tincture of Ferric Citrochloride.	125 cc.
Quinine Hydrochloride.	8 Gm.
Strychnine Sulfate.	0.175 Gm.
Compound Spirit of Orange.	10 cc.
Alcohol.	240 cc.
Glycerin.	300 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Dissolve the quinine hydrochloride in the alcohol, add the compound spirit of orange, then the strychnine sulfate previously dissolved in 10 cc. of distilled water. Then add successively the glycerin, the tincture of ferric citrochloride, and sufficient distilled water to make the product measure 1000 cc.; mix well, and filter, using 10 Gm. of purified talc, if necessary, to clarify the product.

If the solution of ferric chloride from which the tincture of ferric citrochloride is made is not excessively acid and if the tincture has been allowed to stand a few weeks before filtering, this Elixir is permanent as to color and absence of precipitate. If the iron solution is excessively acid, the Elixir becomes red in color.

This is one of the most popular medicated elixirs. The tincture of ferric citrochloride is preferred to one of the scale salts, because the preparation does not darken so readily. Glycerin in place of sugar or syrup also lessens the change in color. Quinine hydrochloride is used rather than the sulphate, because it is more soluble.

Alcohol content--From 22 to 24 per cent, by volume, of C_2H_5OH .

Storage--Keep the Elixir in well-closed containers, protected from light. The Elixir should not be dispensed if markedly darkened in color.

Uses--A general tonic.

Average dose--4 cc.

ELIXIR FERRI, QUININAE ET STRYCHNINAE PHOSPHATUM MF Elixir of Iron, Quinine, and Strychnine Phosphates.
(Elix. Ferr. Quin. et Strych. Phos.--Elixir I. Q. & S. Phosphates)

Soluble Ferric Phosphate.	35 Gm.
Quinine Phosphate.	5 Gm.
Strychnine Phosphate.	0.250 Gm.
Oil of Orange.	1 cc.
Alcohol.	250 cc.
Glycerin.	300 cc.
Distilled Water, a sufficient quantity, To make.	1000 cc.

Dissolve the soluble ferric phosphate in 250 cc. of distilled water by cold maceration, and add 75 cc. of glycerin. Dissolve the strychnine phosphate in the alcohol, and add the oil of orange, the quinine phosphate, and the remainder of the glycerin. Shake until thoroughly mixed; then add the ferric phosphate solution and enough distilled water to make the product measure 1000 cc. Allow the mixture to stand for twenty-four hours, shaking it repeatedly until the quinine phosphate is dissolved. Filter, using 10 Gm. of purified talc, if necessary, to clarify the product.

The Elixir should not be dispensed if markedly darkened in color.

Alcohol content--From 22 to 25 per cent, by volume, of C_2H_5OH .

Storage--Keep the Elixir in well-closed containers, protected from light.

This elixir was popularized as a pharmaceutical specialty and consequently many physicians still write for an "Elixir of the Phosphates of I. Q. & S." It was shown subsequently that the "Phosphates" was only in the title and that the "Specialty" was actually a solution of the chlorides corresponding to the N. F. Elixir of I. Q. & S. (See preceding preparation). The amount of phosphate in the product is so small as to have no therapeutic significance and the ferric phosphate discolors. For these reasons the U.S.P. and N.F. for twenty years (USP IX and X and NF IV and V)

omitted this formula. A new NF Committee has, however, again given it official recognition.

Average dose--4 cc.

ELIXIR ISO-ALCOHOLICUM N.F. Iso-Alcoholic Elixir

(Elix. Iso-Alc.--Iso-Elixir)

Low-Alcoholic Elixir. a certain volume.

High-Alcoholic Elixir. a certain volume.

Mix them.

Low-Alcoholic Elixir

Compound Spirit of Orange. 10 cc.

Alcohol. 100 cc.

Glycerin. 200 cc.

Sucrose. 320 Gm.

Distilled Water, a sufficient quantity,

To make. 1000 cc.

Mix the alcohol, glycerin and 500 cc. of distilled water, add the compound spirit of orange, agitate thoroughly from time to time, and let stand twenty-four hours. Filter through a hard paper filter, retaining, if necessary, the first portions of the filtrate until it passes through clear. Dissolve the sucrose in the filtrate by agitation or percolation, and add enough of the solvent mixture to make the product measure 1000 cc.

Alcohol content--From 8 to 10 per cent, by volume, of C_2H_5OH .

High-Alcoholic Elixir.

Compound Spirit of Orange. 4 cc.

Saccharin. 3 Gm.

Glycerin. 200 cc.

Alcohol, a sufficient quantity,

To make. 1000 cc.

Dissolve the compound spirit of orange and the saccharin in 700 cc. of alcohol, add the glycerin and sufficient alcohol to make the product measure 1000 cc., mix well and filter.

Alcohol Content--From 73 to 78 per cent, by volume, of C_2H_5OH .

Table for Adjustment of Iso-Alcoholic Elixir

<u>Low-Alcoholic</u> <u>Elixir</u>	<u>High-Alcoholic</u> <u>Elixir</u>	<u>Suitable as Vehicle for</u> <u>Preparations on the Following</u> <u>Alcoholic Strengths</u>
1 volume	None	0-10 per cent
4 volumes	1 volume	10-20 per cent
3 volumes	1 volume	20-30 per cent
2 volumes	1 volume	30-40 per cent
1 volume	1 volume	40-50 per cent

1 volume	2 volumes	50-60 per cent
1 volume	3 volumes	60-70 per cent
1 volume	4 volumes	70-80 per cent
None	1 volume	80-95 per cent

Note--Iso-Alcoholic Elixir is intended to serve as a general vehicle for various medicaments that require solvents of different alcoholic strengths. When, therefore, Iso-Alcoholic Elixir is specified in a prescription, the proportion of its two ingredients is to be used that will produce a perfect solution.

For liquid galenicals, the alcoholic strength of Iso-Alcoholic Elixir to be used is approximately the same as that of the menstruum or solvent employed in the preparation of the galenical.

When galenicals of different alcoholic strengths are used in the same prescription, the Iso-Alcoholic Elixir to be used is to be of such alcoholic strength as to secure the best solution possible under the circumstances. This will generally be found to be the average of the alcoholic strengths of the several ingredients.

For non-extractive substances, the lowest alcoholic strength of Iso-Alcoholic Elixir that will yield a perfect solution should be chosen.

ELIXIR PEPSINI COMPOSITUM NF Compound Elixir of Pepsin
(Elix. Pepsin. Co.--Elixir Lactated Pepsin; Compound Digestive Elixir)

Compound Elixir of Pepsin possesses, in each 100 cc. a proteolytic activity equal to not less than 1.75 Gm. of Reference Pepsin.

Pepsin.	35 Gm.
Lactic Acid.	1 cc.
Glycerin.250 cc.
Alcohol.	200 cc.
Oil of Orange.	2 cc.
Tincture of Cudbear.10 cc.
Distilled Water, a sufficient quantity, To make.	1000 cc.

Add the pepsin to 500 cc. of cold distilled water containing the lactic acid, and allow the mixture to stand in a cool place until the pepsin is thoroughly softened; then stir very gently until dissolved, and add the glycerin. Dissolve the oil of orange and the tincture of cudbear in the alcohol and gradually add this solution to the pepsin solution with gentle stirring. Then add sufficient distilled water to make the product measure 1000 cc., and filter until the product is clear.

Note-- Pepsin solutions are reduced in proteolytic activity by agitation and storage, particularly when at or above

room temperature. To insure the dispensing of this Elixir at standard strength, it is required that an excess of pepsin be used in preparing it.

This Elixir was omitted from the N.F. IV. In reinstating it, the formula has been modified by leaving out pancreatin and diastase, thereby making a more scientific preparation. As the Elixir is acid, both pancreatin and diastase would be more or less digested by the pepsin. This, like some other alcoholic solutions of pepsin, which depend mainly on the pepsin for activity, must contain 0.5 Gm. of active pepsin in 30 cc. It is largely used as a vehicle and is similar to various elixirs of lactated pepsin.

Alcohol content--From 16 to 19 per cent, by volume, of C_2H_5OH .

Storage--Keep the Elixir in well-closed containers in a cool place, protected from light, and avoid undue agitation of it.

Uses--A vehicle for nauseating remedies.

Average dose--8 cc.

ELIXIR PHENOBARBITALI N.F. Elixir of Phenobarbital
(Elix. Phenobarb.)

Elixir of Phenobarbital contains, in each 100 cc., not less than 0.38 Gm. and not more than 0.42 Gm. of phenobarbital.

Phenobarbital.	4 Gm.
Tincture of Sweet Orange Peel.30 cc.
Tincture of Cudbear.	7 cc.
Alcohol.	175 cc.
Glycerin.	235 cc.
Syrup.	350 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Dissolve the phenobarbital in the alcohol; add the tincture, the glycerin, the syrup, and sufficient distilled water to make the product measure 1000 cc. Mix well and filter, if necessary, to make the product clear.

Alcohol content--From 17 to 20 per cent, by volume, of C_2H_5OH .

Uses--As an hypnotic and sedative.

Average dose--4 cc.

ELIXIR TERPINI HYDRATIS N.F. Elixir of Terpin Hydrate
(Elix. Terpin. Hyd.)

Terpin Hydrate.	17 Gm.
Tincture of Sweet Orange Peel.	20 cc.
Spirit of Bitter Almond.	5 cc.
Alcohol.	425 cc.
Glycerin.	400 cc.

Syrup.	100 cc.
Distilled Water, a sufficient quantity,	
To make.	<u>1000 cc.</u>

Dissolve the terpin hydrate in the alcohol; add successively the tincture, the spirit, the glycerin, the syrup, and sufficient distilled water to make the product measure 1000 cc.; mix well and filter until the product is clear.

Alcohol content--38 to 42 per cent, by volume, of C_2H_5OH .

N.F. Preparation--Elixir Terpini Hydratis et Codeinae.

This preparation is prepared by the addition of 2 Gm. of Codeine to 1000 cc. of Elixir of Terpin Hydrate.

Uses--A stimulant for secretions in bronchitis.

Average dose--4 cc.

Note--The high alcohol content in this elixir is required for the solution of the terpin hydrate. The formula as given in the N. F. III made a preparation which gave trouble, because terpin hydrate, or more often sugar, crystallized out. Terpin hydrate is sparingly soluble in water, and to prevent precipitation, so much alcohol was used that the sugar crystallized from the syrup. The trouble is now remedied by using a little more alcohol and some water in place of part of the syrup.

ELIXIRS

Definition:

In general, what is the effect of long storage on Elixirs?

How do Elixirs differ from spirits?

List the U.S.P. Elixirs.

As a group how are Elixirs used?

How many Elixirs are recognized by the N. F.?

List three official filtering agents.

Why is talc or other filtering agents used in preparing Elixirs?

Why should the filter be wetted with at least a 25 per cent alcohol solution before filtering elixirs?

ELIXIR AROMATICUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc. by modified formula.

Formula: USP Method.

Formula: Modified Method.

State the alcohol content.

Why is the syrup added to the alcohol and spirit of Orange Comp?

Uses.

Description and physical properties.

ELIXIR BROMIDORUM TRIUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc.

Formula:

Use and Dose.

Description.

ELIXIR FERRI, QUINNAE ET STRYCHNINAE

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 240 cc.

Formula:

Why is quinine hydrochloride used in this preparation?

Use and dose.

How much Strychninae Sulfate per dose.

Why has it been suggested that Brucine be substituted for Strychninae?

Description.

What precaution should be used in dispensing this preparation?

What may cause a color change in this preparation.

ELIXIR ISO-ALCOHOLICUM

O.E.T. N.F. or U.S.P.

LOW - Alcoholic Elixir

Prepare 120 cc.

Formula:

HIGH - Alcoholic Elixir

Prepare 120 cc.

Formula:

Give table for Adjustment of Iso-Alcoholic Elixir.

Intended use:

What type of preparation is this elixir to be dispensed with?

ELIXIR PEPSIMI COMPOSITUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 240 cc.

Formula:

Give the N. F. "note" under this preparation.

Define "proteolytic activity."

What is the function of the acid in this Elixir?

State the percentage of acid in this Elixir.

Use and doses.

Storage.

Description and physical properties.

ELIXIR PHENOBARBITALI

O.E.T. U.S.P. or N.F.
Syn. Abbr.

Requirement:

Prepare 120 cc.

Formula:

Uses and doses.

Give the content of phenobarbital, in grains, in one average dose.

Storage.

Description and physical properties.

Alcoholic content.

ELIXIR TERPINI HYDRATIS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 120 cc.

Show Calculations.

Formula:

Why is the present formula for elixir of terpin hydrate better than that of the N. F. III?

Dose:

Uses:

Description.

TINCTURES

Tinctures are liquid preparations made by extracting the useful principles from drugs by the use of appropriate menstrua or solvents containing alcohol. There are, however, several exceptions, in which chemical substances are dissolved in alcoholic liquids. Tinctures differ from spirits in being made from non-volatile bodies, the tinctures containing volatile constituents extracted from drugs and those containing iodine are exceptions to this rule. They are made by percolation, maceration, solution, or dilution, and the menstrua employed in the official tinctures are alcohol, dilute alcohol of various strengths, aromatic spirit of ammonia, ether, ammonia water, or mixtures of alcohol, water and glycerin. In some unofficial tinctures, spirit of ether, ammoniated alcohol, and spirit of nitrous ether are used. The use of alcohol as a solvent for the active or useful principles in drugs has been practiced for many years, but it has required a long time and much experience to determine the proper proportion of water to add to the alcohol. The menstrua should dissolve the therapeutically valuable constituents of the drugs without extracting the inert principles, and yet contain sufficient alcohol to secure permanent preparations that will not in time deposit a portion of their active constituents. The advantages of alcohol as a menstruum have been proved so thoroughly, that the use of aqueous preparations has greatly declined in this country; and yet there are some instances, particularly in the case of the weak tinctures and those requiring a large dose, in which the therapeutic action of the menstruum almost equals that of the drug. In these cases, however, the physician may prefer the fluidextract when he does not desire the stimulating action of the alcohol in the tincture. On the whole the use of tinctures and fluidextracts has notably decreased, and their place is taken by drugs in the form of tablets or capsules or by those prepared for parenteral administration.

In selecting the menstrua the proportion of water in each case is made as high as possible without endangering the permanency of the preparation, one especial advantage being that such tinctures may be added in small proportions to aqueous preparations without serious precipitation. In this respect tinctures have usually a great advantage over fluidextracts, and weaker alcoholic menstrua are often used successfully for tinctures when they would be entirely unsuitable for fluidextracts. This may be explained by the fact that tinctures, on account of their comparative weakness, have a much larger proportion of menstruum than fluidextracts with which to exhaust the drug, and may therefore have the excess over the proportion of alcohol used in the fluidextract made up with water. It has been proved that a pint of diluted alcohol will extract by percolation a larger proportion of the soluble principles of a drug than half a pint of alcohol and half a pint of water percolated separately through the drug. The properties of alcohol will be considered separately, yet it seems desirable to note here the solvent properties of this valuable preservative. It mixes freely with water, ether, acetic acid, a number of volatile oils, and castor oil; it dissolves resins, stearoptens, tannins, organic acids,

chlorophyll, alkaloids, balsams, iodine, ferric chloride, ammonium carbonate, etc. Diluted alcohol extracts from drugs; gum, extractive, chlorophyll, albumin, coloring matter, resins, volatile oils, alkaloids, sugar, tannin, etc. Glycerin is used in tinctures to prevent precipitation by retaining in solution principles which would otherwise in time be deposited.

The Strength of Tinctures--For many years there was no uniformity in the proportion of drug to finished tincture but the Brussels Protocol of 1902 established a general principle which has brought about international uniformity. The Protocol agreement provided for 10 per cent drug strength in tinctures of potent or therapeutically active drugs and 20 per cent strength for other tinctures. There is practical conformity to this agreement in the U.S.P., the strength, however, being slightly differently expressed, i.e., 10 Gm. of potent drug represented by 100 cc. of tincture, instead of 10 per cent, by weight, and 20 Gm. per 100 cc. for others. The difference is negligible, simply meeting the conditions in this country where finished products are usually measured instead of weighed.

There are several exceptions to this general rule, as in tincture of iodine (7 Gm. per 100 cc.) and in the tinctures of orange peel and lemon peel (50 Gm. per 100 cc.), but special conditions governed the decisions in these cases.

A number of tinctures are to be assayed and the final volume adjusted to conform with the rubrics, but the standard of strength adopted represents an average drug in an amount equivalent to the international agreement.

PREPARATION--There are three different methods represented in the processes for making tinctures: 1. By percolation. 2. By maceration. 3. By solution or dilution.

1. By Percolation--This is the best method for making tinctures, when the drugs are capable of being readily comminuted and extracted, and it is always directed by the Pharmacopoeia when practicable. The special advantages of percolation over maceration and expression are seen in the saving of time and labor, and in the greater efficiency of the product if the process has been carefully and skilfully performed. The U.S.P. has provided a Type Process for tinctures which are to be made by Percolation. In the text under the title only the drug, the size of the powder, and the menstruum are given, and reference is then made to the Type Process which is as follows:

Type Process P --- Percolation

Carefully mix the ground drug or mixture of drugs with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp, transfer it to a suitable percolator, shake it down evenly, allow it to stand for fifteen minutes, and then pack the drug firmly. Pour on enough of the prescribed menstruum to satu-

rate the drug, cover the top of the percolator, and, when the liquid is about to drip from the percolator, close the lower orifice, and allow the drug to macerate for twenty-four hours, or for the time specified in the formula. If no assay is directed, allow the percolation to proceed at the specified rate, gradually adding sufficient menstruum to obtain 1000 cc. of tincture, and then mix the product thoroughly.

Modification for Assayed Tinctures. In preparing a tincture which is to be adjusted to a standard, proceed as directed above but collect only 950 cc. of percolate; mix the product thoroughly, and assay a portion of it as directed. Dilute the remainder of the liquid with such quantity of the prescribed menstruum as calculation from the assay indicates is necessary to produce a tincture that conforms to the prescribed standard. Mix the product well.

2. By Maceration--This method of making tinctures is officially used in the case of resins, balsams, gums, soap, etc., where the practical difficulties likely to be encountered in percolation would offset any advantages that the latter process might possess. The U.S.P. also provides a Type Process for tinctures to be made by Maceration, only giving the title, drug, size of powder, and the menstruum, with reference to the Type Process, which is as follows:

Type Process M --- Maceration

Macerate the drug or mixture of drugs in a stoppered container, in a moderately warm place, with 750 cc. of the prescribed menstruum, agitating it frequently for three days or until the soluble matter is dissolved. Transfer the mixture to a filter, and, when most of the liquid has drained away, wash the residue on the filter with a sufficient quantity of the prescribed menstruum, combining the filtrates, to obtain 1000 cc. of tincture. Mix the product well.

3. By Solution or Dilution--A few tinctures are made in this way, such as tincture of iodine, by dissolving iodine in a solution of potassium iodide and adding alcohol; tincture of ferric chloride, by diluting the solution of ferric chloride with alcohol etc.

Storage--Tinctures should be stored in tightly stoppered containers and should not be exposed during storage to direct sunlight or to temperatures above the normal temperature of living rooms.

TINCTURA IODI U.S.P. Tincture of Iodine (Tr. Iodi)

An alcoholic solution of iodine and potassium iodide containing, in each 100 cc., not less than 6.5 Gm. and not more than 7.5 Gm. of I, and not less than 4.5 Gm. and not more than 5.5 Gm. of KI.

Tincture of Iodine may be prepared as follows:

Iodine.	70 Gm.
Potassium Iodide.	50 Gm.
Distilled Water.	50 cc.
Alcohol, a sufficient quantity,	
To make.	1000 cc.

Dissolve the potassium iodide in the distilled water contained in a bottle graduated to 1000 cc.; add the iodine, and agitate the mixture until solution is effected. Then add sufficient alcohol to make 1000 cc. of Tincture, and mix thoroughly.

The water has been added to this formula to assist in the solution of the iodine, which, in the presence of the potassium iodide, is rendered readily soluble. The potassium iodide was not introduced, however, to increase the iodine solubility, although advantage is taken of its presence to aid in the rapidity of solution, but it is added as a preservative and when present prevents the rapid change of iodine to hydriodic acid. It is, therefore, important not to omit it from the formula.

Alcohol content--From 80 to 85 per cent, by volume, of C_2H_5OH .

Storage--Preserve Tincture of Iodine in glass bottles, closed with stoppers resistant to corrosion, and in a cool place, protected from light.

Uses--Applied locally as a counterirritant, and also for its effect in sprains, chronic rheumatism, gout, chilblains, enlarged glands, and lymphnodes, and under many other conditions. It should not be used on the skin in repeated applications as the evaporation of the alcohol leaves almost pure iodine which is very irritating and caustic.

It is extensively used to sterilize the skin before minor operations or injections, for disinfecting wounds, and in treating erysipelas. For these purposes a half-strength preparation (3.5 per cent) is usually employed. In this strength it is frequently available in ampuls for first-aid treatment. The new U.S.P. Mild Tincture of Iodine, which follows, is intended as a first-aid antiseptic dressing and for use in preparing the field for operations and will safely replace the "half-strength tincture" now so widely used. The International Protocol (P. I.) Tincture of Iodine contains 10 per cent of iodine in 95 per cent alcohol.

Average dose-- 0.1 cc.

TINCTURA IODI MITIS U.S.P. Mild Tincture of Iodine
(Tr. Iodi Mit.)

Mild Tincture of Iodine contains, in each 100 cc., not less than 1.8 Gm. and not more than 2.2 Gm. of I and not less than 2.1 Gm. and not more than 2.5 Gm. of NaI.

Mild Tincture of Iodine may be prepared as follows:

Iodine.	20 Gm.
Sodium Iodide.	23 Gm.
Diluted Alcohol, a sufficient quantity,	
To make.	1000 cc.

Dissolve the iodine and sodium iodide in a sufficient quantity of diluted alcohol to make the product measure 1000 cc.

Alcohol content--From 44 to 48 per cent, by volume, of C_2H_5OH .

Storage--Same as for Tincture of Iodine.

Uses--As indicated under Tincture of Iodine, a "half strength tincture" has been extensively used as a germicide on the skin and in minor injuries. This 2 per cent tincture is equally efficient and less irritating and it is claimed that sodium iodide is preferable to the corresponding potassium salt due to its being less toxic to the tissues.

TINCTURA AURANTII DULCIS U.S.P. Tincture of Sweet Orange Peel
(Tr. Aurant. Dulc.)

Sweet Orange Peel, the outer yellow rind grated from the fresh fruit.	500 Gm.
To make.	1000 cc.

Prepare a tincture by Process M, macerating the drug in 1000 cc. of alcohol and completing the preparation with alcohol. Use purified cotton as the filtering medium.

The white portion of the rind must not be used, as the proportion of oil, which is only in the yellow rind, is reduced and the bitter principle hesperidin is introduced. This tincture replaces the spirit of orange formerly official because it has a finer flavor.

Alcohol content--From 73 to 76 per cent, by volume, of C_2H_5OH .

USP Preparation--Syrupur Aurantii.

NF Preparations--Elixir Gentianae Glycerinatum; Elixir Pepsini et Benini Compositum; Elixir Taraxaci Compositum; Elixir Terpini Hydratis.

Uses--A flavor, used in syrups, elixirs and emulsions. This tincture was introduced to insure a delicate orange flavor direct from the fruit instead of depending upon the oil of orange which so frequently is terebinthinate and unfit for use. The tincture keeps well.

Average dose--4 cc.

TINCTURA BALSAMI TOLUTANI U.S.P. Tincture of Tolu Balsam
(Tr. Balsam. Tolu.--Tinctura Tolu, USP X; Tolu Tincture)

Tolu Balsam.	200 Gm.
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To make.	1000 cc.
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Prepare a tincture by Process M, using alcohol as solvent.
Alcohol content--From 80 to 85 per cent, by volume, of

C_2H_5OH .

USP Preparation--Syrupus Balsami Tolutani.

Uses--A balsamic preparation employed as an addition to expectorant mixtures. Also used in the preparation of the syrup and in applying a coating to oxidizable pills.

Average dose--2 cc.

TIKTURA FERRI CITROCHLORIDI N.F. Tincture of Ferric Citrochloride.

(Tr. Ferr. Citrochlor.--Tasteless Tincture of Ferric Chloride: Tasteless Tincture of Iron)

Tincture of Ferric Citrochloride is a hydro-alcoholic solution containing, in each 100 cc., ferric citrochloride equivalent to not less than 4.48 Gm. of Fe.

Solution of Ferric Chloride.	350 cc.
Sodium Citrate.	450 Gm.
Alcohol.	150 cc.
Water, a sufficient quantity,	
To make.	1000 cc.

Mix the solution of ferric chloride with 150 cc. of water and dissolve the sodium citrate in this mixture with the aid of gentle heat. Then add the alcohol, and when the solution has become cold, add sufficient water to make the product measure 1000 cc. Set the Tincture aside in a cold place for a few days, so that the excess of saline matter may separate, and then filter.

Alcohol content--From 13 to 15 per cent, by volume, of

C_2H_5OH .

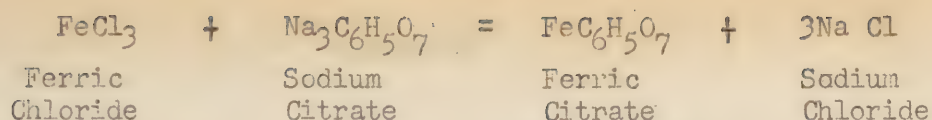
N.F. Preparations--Elixir Ferri, Quininae et Strychinae; Elixir Gentianae et Ferri.

Storage--Keep the Tincture in amber-colored bottles.

Uses--An iron tonic, employed where tannins are likely to be present, since this form of iron only slightly darkens the preparation.

Average dose--0.5 cc.

Chemical reaction takes place by which a part of the ferric chloride is changed to citrate. The color changes to a dark green; probably a double compound is formed. This tincture is one which can often be used advantageously in place of the U.S.P. tincture because it does not give nearly as many incompatibilities, the citrate present preventing them. It deserves more attention than is given it. The iron strength of the two tinctures is the same, but not the alcohol strength. The saline matter which separates is sodium chloride, thrown out of solution by alcohol. Although called tasteless, it is not tasteless, but does not have the styptic taste that the other tincture has.



TIKTURA BELLADONNAE U.S.P. Tincture Belladonna
(Tr. Bellad.---Tinctura Belladonnae Foliorum, U.S.P. IX)

Each 100 cc. contains 0.027 to 0.033 Gm. of Belladonna alkaloids.

This tincture may be prepared from the Fluidextract of Belladonna Root by using 1/15 the amount of the finished tincture as the fluidextract and add a sufficient quantity of 70% alcohol to finish the product. Fluidextract of Belladonna Root contains 0.45 Gm. of alkaloids per 100 cc. or 15 times the amount of alkaloids represented by the same amount of Tincture of Belladonna.

Alcohol Content--From 44 to 47 per cent, by volume, of $\text{C}_2\text{H}_5\text{OH}$.

Uses--Stimulates the higher centers, hence used in asthma and to quicken the pulse; used to modify the action of vegetable purgatives. Used externally in neuralgia.

Average dose--0.6 cc.

TIKTURA HYOSCYAMI U.S.P. Tincture of Hyoscyamus
(Tr. Hyosc.)

Each 100 cc. contains 0.0055 to 0.0075 Gm. of hyoscyamus alkaloids.

This tincture may be prepared from the Fluidextract of Hyoscyamus by using 10% of the fluidextract and adding a sufficient quantity of 60% alcohol to make the finished product. This is 10% per cent tincture as the fluidextract represents 1 Gm. of the crude drug in each cc.

Alcohol Content--From 44 to 46 per cent, by volume, of $\text{C}_2\text{H}_5\text{OH}$.

Uses--Similar to belladonna, but preferable to the latter drug in insomnia and for relieving the excitement of insanity.

Average dose--2 cc.

TINCTURES

Definition:

Give the essentials of the U. S. P. monograph on tinctures.

Outline processes P and M for preparing tinctures.

In process P. why is the moistened drug macerated 24 hours before percolating?

Why are not all tinctures prepared by maceration?

In what respects do tinctures and spirits differ?

What different solvents (menstruum) are used in preparing tinctures?

How rapidly should tinctures be percolated in general?

How should tinctures, in general, be stored?

Give the formula and method of preparation of Tincture of Mercurochrome.

TINCTURA IODI

C.E.T. U.S.P. or N. F.

Syn. Abbr.

Requirement:

Prepare 90 cc.

Formula:

What precaution should be taken when dispensing Tincture of Iodi to the operating room?

What is the function of the potassium iodide?

Why is water used in dissolving the potassium iodide?

Storage.

Description and physical properties.

TINGTURA ABUANTII DULCIS

O.E.T. U.S.P. or N. F.

Syn. Abbr.

Prepare 100 cc.

Formula:

What part of the rind is not used and why?

Use and Dose.

TINGTURA BALSAMI TOLUTANI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 90 cc.

Show Calculations.

Formula:

Use.

Dose.

TINCTURA FERRI CITROCHLORIDI

O.E.T. U.S.P. or N. F.

Syn. Abbr.

Requirement:

Prepare 100 cc.

Formula:

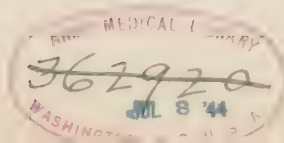
Why does a deposit form in the preparation of Ferric Citrochloridi?

Why is the Tincture of Ferric Citrochloridi better than the Tincture of Ferric Chloridi from a therapeutic standpoint?

List N. F. preparations.

How may one detect an excessive amount of acid in the Iron Solution by the color of the tincture?

Use and doses:



TINGTURA BELLADONNAE

O.E.T. U.S.P. or M.F.

Syn. Abbr.

U.S.P. XI Title:

Requirement:

Prepare 100 cc.

Formula:

Measure exactly one fluid dram of the finished tincture and using an ordinary medicine dropper count the number of drops in the fluid dram.

Record your results.

Number of minims in 1 fluid dram.	Number of drops accurately counted from 1 fluid dram.	Relation of drops to 1 minim.
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Define "official medicine dropper."

Uses.

Doses.

Description and physical properties.

"From the above calculations, how many drops from the dropper used would be necessary to deliver a U.S.P. dose?"

TINGTURA HYOSCYAMI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 60 cc.

Formula:

Average dose:

Average dose of fluidextract:

Uses.

FLUIDEXTRACTS

Fluidextracts are liquid alcoholic preparations of uniform and definite strength, made by percolating drugs with menstrua, and concentrating a portion of the percolate so that in each case one cc. represents the medicinal virtues of one Gm. of the standard drug; they are mostly concentrated percolates. Fluidextracts were official for the first time in 1850 and the list was then made up of seven concentrated preparations, although but one of these could be called a fluidextract within the present meaning of the term. Fluidextracts are not as frequently prescribed today as was the custom twenty years ago. They are, however, frequently recommended by manufacturing pharmacists as concentrated drug preparations for making tinctures and syrups. In the N. F. VI, for the first time, this practice has been given official recognition for the N. F. tinctures. The provision is made, however, that the tincture so prepared must correspond in drug strength, in alcohol content, and in content of other menstruum ingredients, to one prepared directly from the drug by the official process. The U. S. P. XI contains formulas for eleven and the N. F. VI for seventy-one fluidextracts. They may be justly called "American preparations," their development being largely due to the investigations of American pharmacists. The striking advantages possessed by fluidextracts are: 1. Permanence. 2. Concentration. 3. The uniform relation existing between the fluidextract and the drug.

In the U.S.P., one word "Fluidextractum," has been adopted in place of two words, "Extractum Fluidum," formerly used. The object of this change was to avoid the confusion heretofore existing due to the alphabetical arrangement, which compelled Fluidextracts to be printed with the "Extracts; thus, "Extractum Rhei" had to be followed by "Extractum Rhei Fluidum." By making the Latin name for fluidextracts "Fluidextractum," these preparations are now under the letter F instead of E. The English name is, of course, "Fluidextract" instead of "Fluid Extract."

Permanence is secured by the use of alcoholic menstrua; formerly sugar and glycerin were relied upon as preservatives, but continued experience has developed the value of alcohol, so that at present it is most largely used as the solvent. Glycerin, however, is used in the menstruum of some fluidextracts, notably those containing tannin, and has a tendency to retard precipitation.

Concentration enables the physician to decrease the bulk of the dose, diminishing the volume of the preparation so that portability is secured and any therapeutic action from the menstruum largely eliminated. It also aids greatly in securing permanence.

The uniform relation existing between the fluidextract and the drug is of great assistance to the physician in fixing the dose, because, as 1 cc. represents 1 Gm. of drug, the dose of the fluidextract must be practically the same as that of the drug. It has also obvious advantages in the arrangement of the formulas and in working from them.

The official fluidextracts are standardized whenever made from a drug capable of being assayed either chemically or biologically.

PREPARATION--The official fluidextracts are made by the process of percolation, the menstruum to be used being specified in each case. The manufacture by the usual process calls for concentration of the more dilute portion of percolate by distillation: this should be done in a vacuum distillation apparatus, the temperature in the still being kept below 60° C.

The time of maceration and the rate of flow during percolation are varied for different drugs to compensate for peculiarities in extraction and in some cases to accomplish partial rejection of non-active or chemically incompatible constituents. In all cases the maceration and rate of flow are designed to extract completely the medicinally active or important constituents from the specified quantities of drug; but the time and rate specified may be varied to accomplish this purpose when larger or smaller quantities of drug are being treated.

Usually a cylindrical form of percolator is the best type for making fluidextracts, but for use with drugs which swell considerably in the menstruum a flaring form of percolator may be preferred.

The rate of flow of the percolate is directed in these terms; "percolate slowly," "percolate rapidly," and "percolate at a moderate rate." With reference to the extraction of 1000 Gm. of drug, "percolate slowly" means a rate not exceeding 1 cc. of percolate per minute; "percolate rapidly" means a rate of from 3 to 5 cc. per minute; "percolate at a moderate rate" means a rate of from 1 to 3 cc. per minute.

Fluidextracts are made in several ways. The manufacturer generally adopts a different process from that directed by the Pharmacopoeia, because upon the large scale some practical modifications are necessary; the finished preparation must, however, be brought to the official standard. The process at present in use may be classified as follows: 1. Percolation with partial evaporation. 2. Fractional or divided percolation. 3. Hot water exhaustion, evaporation and preservation.

In the preparation of fluidextracts by the appended type processes A, B, or C, the rate of percolation must be carefully controlled and, for the quantities directed in the formulas of the Pharmacopoeia, the flow should not exceed ten drops per minute until the percolate to be reserved is collected, and twenty drops per minute thereafter. One thousand Gm. of powdered drug may frequently be exhausted by percolation with sufficient menstruum to yield 3000 cc. of percolate, but in all cases the percolation should be continued until the drug is practically exhausted.

1. PERCOLATION AND PARTIAL EVAPORATION--This process is well illustrated by the Process A and B of the Pharmacopoeia, as follows:

Process A--This process is used for preparing fluidextracts which are made with menstrua of alcohol or with mixtures of alcohol and water by ordinary percolation.

Carefully mix 1000 Gm. of ground drug with a sufficient quantity of the prescribed menstruum to render it evenly and distinctly damp. This usually requires from 600 cc. to 800 cc. of menstruum. Allow the dampened drug to stand for about fifteen minutes, then pack it firmly in a suitable percolator, and pour on sufficient menstruum to saturate the drug and leave a stratum above. When the liquid is about to drop from the percolator, close the lower orifice, cover the percolator and allow the drug to macerate for about the prescribed period of time. Then proceed with the percolation at the specified rate, adding fresh menstruum as needed until the drug is exhausted of its active principles. Reserve the first 850 cc. of percolate (unless otherwise directed in the formula), recover the alcohol from the percolate subsequently collected and concentrate the residue to a soft extract at a temperature not exceeding 60° C. Dissolve this extract in the reserved percolate, and, if no assay is directed, add enough of the menstruum to make the fluidextract measure 1000 cc. and mix thoroughly. In case the fluidextract being prepared is to be adjusted to a standard, assay a portion of the reserved percolate in which the soft extract has been dissolved, and dilute the remainder to the volume determined as necessary by calculation from the assay, using a sufficient quantity of the prescribed menstruum as the diluent. Mix the product well.

Process B--This process is used in preparing fluidextracts the menstrua for which contain, in addition to alcohol, or a mixture of alcohol and distilled water, definite quantities of other components such as an acid or glycerin, the two menstrua being successively employed.

Carefully mix 100 Gm. of the ground drug with a sufficient quantity of Menstruum I (containing the special ingredient) to render it evenly and distinctly damp. From 600 cc. to 800 cc. of menstruum is usually required. Allow the dampened drug to stand for about fifteen minutes, then pack it firmly in a suitable percolator, and pour on the remainder of Menstruum I. When the liquid is about to drop from the percolator, close the lower orifice, cover the percolator and allow the drug to macerate for about the prescribed period of time. Then proceed with the percolation at the specified rate and, when the first menstruum has disappeared from the surface of the drug, use Menstruum II as needed until the drug is exhausted of its active principles. Reserve the first 850 cc. of percolate, recover the alcohol from the percolate subsequently collected, and evaporate the residue to a soft extract at a temperature not exceeding 60° C. Dissolve the extract in the reserved percolate, and if no assay is directed, add

enough of Menstruum II to make the fluidextract measure 1000 cc. and mix thoroughly. In case the fluidextract being prepared is to be adjusted to a standard, assay a portion of the reserved percolate in which the soft extract has been dissolved, and dilute the remainder to the volume determined as necessary by calculation from the assay, using a sufficient quantity of Menstruum I as the diluent. Mix the product well.

The precipitation experienced heretofore when the evaporated weak percolate was added to the reserved portion is considerably diminished by causing the former to be evaporated to a soft extract. This precipitation, formerly noticed more particularly in alcoholic fluidextracts, was due to the volatility of the alcohol in the weak percolates, which, when evaporated, left the residue to a great extent aqueous; when this residue was added to the strongly alcoholic reserved portion, a precipitation of resinous and frequently of active matter took place, which necessitated the storing of the fluidextract until precipitation ceased, and subsequent filtration. This is almost altogether avoided by evaporating to a soft extract, and the loss of activity through precipitation is thus greatly diminished.

The argument is frequently advanced that the application of heat is detrimental to solutions of organic principles, that it dissociates some, and always proves injurious to the desirable constituents, and that no heat whatever should be used in making fluidextracts; these views are undoubtedly correct, when considered in connection with a few special cases, but do not apply with any practical force to the moderate use of heat where recommended by the official processes upon that portion of the percolate which represents the least active and least desirable constituents of the drug, for from seven-tenths to nine-tenths of the whole amount of percolate (frequently representing ninety-five per cent of the activity of the drug) is reserved and is not subjected to heat at all. The official process of "fractional percolation" may, however, be applied to any fluidextract directed to be made by Type Process A and by this method the application of all heat is avoided. This process will now be considered:

2. FRACTIONAL OR DIVIDED PERCOLATION--Process C--This process is used for preparing fluidextracts, the constituents of which are injured by heat, or as a desirable alternative for Processes A, or B, or in case suitable facilities for distillation and concentration are lacking. When Process B is adapted to Process C, Menstruum I only is used throughout the percolation.

Divide 1000 Gm. of the ground drug into three portions, consisting of 500 Gm., 300 Gm., and 200 Gm., respectively. Mix the first portion (500 Gm.) with sufficient of the prescribed menstruum to render it evenly and distinctly damp, transfer the dampened powder to a suitable percolator, the capacity of which should not greatly exceed the bulk of the moist drug when packed firmly, and allow it to stand for about fifteen minutes. Then pack the drug in the percolator, saturate it with the menstruum,

and allow it to macerate for about the prescribed period of time. Then proceed with the percolation, first collecting and reserving 200 cc. of percolate, and afterward collecting five successive portions of percolate of 300 cc. each, numbering them in the order in which they are obtained.

Dampen the second portion (300 Gm.) of the drug with a sufficient quantity of the first of the 300 cc. portions of percolate from the preceeding lot of drug, and carry out the percolation as just directed for the first lot, excepting that the five 300 cc. portions of the percolate from the first lot of drug shall first be used as menstruum, in the order in which they were received, followed, if necessary, by sufficient fresh menstruum to supply the following portion of percolate: reserve the first 300 cc. of percolate and then collect five successive portions of 200 cc. each numbering them in the order in which they are collected.

Now dampen the third portion (200 Gm.) of the drug with a sufficient quantity of the first numbered portion of percolate from the second lot of drug and proceed with the percolation as before, using as the menstruum the successive 200 cc. portions of percolate from the second lot of drug in the order received. If no assay is directed, collect and reserve 500 cc. of percolate. Mix the three reserved percolates from the three lots of drugs to make 1000 cc. of fluidextract.

If the fluidextract being prepared by Process C is to be adjusted to a standard, collect and reserve only 420 cc. of percolate from the third portion of drug instead of the 500 cc. directed above. Mix the three reserved percolates from the three lots of drug and assay a portion of the mixture; dilute the remainder to the volume determined as necessary by calculation from the assay, using as the diluent a sufficient quantity of menstruum of the same alcoholic strength as the original. Mix the product well.

The credit for the development of the fractional percolation method which so ingeniously avoids the use of heat, is given Dr. E. R. Squibb. It is recommended in the Pharmacopoeia for the preparation of fluidextract of ergot and in the National Formulary for fluidextract of aconite, in which heat would be injurious, rendering the alkaloid inactive, and also by both the U.S.P. and the N.F. for any fluidextract for which Process A or B is directed.

3. HOT WATER EXHAUSTION AND EVAPORATION--This method has been adopted for several official fluidextracts in which the active constituents are soluble in water. The making of fluidextracts by this process is very economical and may be used to advantage by pharmacists. It is directed in the U.S.P. for such drugs as cascara sagrada. The process is as follows:

Process D--This process is used for preparing fluidextracts with boiling distilled water as the menstruum, alcohol being added as a preservative to the concentrated percolate.

To 1000 Gm. of the coarsely ground drug add about 3000 cc of boiling distilled water, mix well, and allow it to macerate in a suitable, covered, metallic percolator for two hours. Then allow the percolation to proceed at the specified rate, gradually adding boiling distilled water until the drug is exhausted. Evaporate the percolate on a water bath to the volume specified, cool, add the alcohol, and allow the mixture to stand in a stoppered container for seven days. Then decant the clear liquid, filter the remainder into the decanted liquid, and wash the residue on the filter with a sufficient quantity of a mixture of alcohol and distilled water, of the same alcoholic strength as the filtered liquid, to make the fluidextract measure 1000 cc. Mix the product well.

PRESERVATION OF FLUIDEXTRACTS--Very little trouble is experienced in keeping fluidextracts which have been properly made. The Pharmacopoeia directs storage as follows: "Preserve Fluidextracts in tightly closed containers and protected from direct sunlight or abnormal temperatures." It is usually customary, after keeping the newly made fluidextract for one month, to decant the clear portion from any sediment, filter the remainder and thoroughly mix the liquids before storing. Precipitation to a greater or less extent will certainly take place. This is often especially noticeable in fluidextracts made during warm weather, and is due to the greater solvent action of the menstruum at higher temperatures. Precipitation is also caused by the variation in the strength of different portions of the menstruum in an alcoholic fluidextract; the first part of the percolate which is received contains the displaced water which was present as moisture in the powder, and the mixture of this with the strong alcoholic percolate which follows causes some precipitation. The character of the precipitate should be ascertained in each case; if active, it should be incorporated by shaking with the fluidextract; if inert, it should be filtered out.

Some manufacturers make a practice of aging and storing fluidextracts in glass-lined or enameled tanks. Experience has shown, however, that tight wooden containers (alcohol barrels are excellent for the purpose) are preferable, as fluidextracts aged in wood will remain clear and free from sedimentation much longer than those aged in glass or enameled vessels.

ACETIC FLUIDEXTRACTS, OR FLUIDACETRACIS--These were proposed by C. F. Squibb, and consist of preparations made like fluidextracts of definite strength, Gm. or cc. but made with acetic acid or diluted acetic acid of various strengths. The advantages claimed for them are cheapness, permanence, and miscibility with aqueous liquids, but they have the disadvantage of the presence of acetic acid, which is not always desirable, and the loading of the finished preparation with inert constituents

for which acetic acid is a good solvent. This class of preparations has not gained favor.

Fluidextracts from Fresh Drugs--Fluidextracts of this character have been used to some extent, and may be made by crushing the drug, obtaining the liquid by pressure, and adding alcohol or diluted alcohol, according to the nature of the drug, re-pressing, and making the final product represent one gram in each cc. Owing to the varying proportion of water found in fresh drugs, it is evident that each preparation must be made from a special formula, and the quantity of alcohol to be added must depend upon the amount of water present in the drug; for drugs containing principles which are volatile or easily dissociated, this method produces good preparations, but unusual care must be exercised to secure uniformity.

Alcoholic Percentage of Fluidextracts--The National Food and Drugs Act requires that the percentage of alcohol by volume, in all preparations containing alcohol, be stated on the label. The percentage of alcohol in fluidextracts made by type process A, B, or C, is variable and always less than that in the menstruum employed, due, among other causes, to loss of alcohol by evaporation during manufacture, the presence of variable proportion of water in the air-dried drug, and to the extraction from the drug of its soluble constituents, which also often vary greatly in different lots of the same drug. The percentage of alcohol in the finished product can therefore only be ascertained by an actual determination, but the average alcohol content is given after each official fluidextract.

FLUIDEXTRACTUM RHEI N.F. Fluidextract Rhubarb
(Flext. Rhei)

Prepare the Fluidextract from Rhubarb, in moderately coarse powder, by Process A (see beginning of this section). Use a mixture of 4 volumes of alcohol and 1 volume of water as the menstruum, macerate the drug twelve hours, and percolate rapidly.

Alcohol Content--From 55 to 63 per cent, by volume, of C_2H_5OH .

N. F. Preparations--Elixir Rhei Alkalinum; Mistura Rhei Composita; Syrupus Rhei.

Uses--A cathartic, used in making other rhubarb preparations.

Average dose--1 cc.

FLUIDEXTRACTS

Definition:

Compare the U.S.P. and N.F. definitions of fluidextracts.

Abstract the essentials of the U.S.P. and N.F. monograph on fluid-extracts.

Why is the menstruum for a fluidextract sometimes different from the menstruum used to prepare the extract of the same drug?

At what temperature should fluidextracts be concentrated?

In Process "A" why is the percolate collected in two portions?

In Process "B" why is the glycerin or acid used only in the first menstruum?

FLUID EXTRACTS
(Continued)

What are the advantages of Process "C"?

For what type of drug is Process "D" satisfactory?

Why are fluidextracts usually aged before dispensing?

Give three principle advantages of fluidextracts.

List the U.S.P. Fluidextracts.

How many fluidextracts are recognized in the N.F.?

Briefly outline Processes A, B, C, and D.

FLUIDEXTRACTUM RHET

C.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 60 cc.

Formula:

Why is the drug dampened before placing in percolator?

Why should the drug be packed in layers?

Why is the first 850 cc. of extract used as the reserved portion?

Use and Dose.

N. F. Preparation.

LINIMENTS

A liniment is a liquid preparation with few exceptions, to be applied externally with friction, having as its base alcohol, a mixture of alcohol and water, a fixed oil, a volatile oil, or solution of soap. Difficulty is rarely experienced in making liniments, as they are often mixtures of immiscible liquids, or liquids and solids, and are generally dispensed with a "shake well" label. Water is not a good vehicle, because it and the agent dissolved in it are not readily absorbed. The fixed oils most commonly used are cottonseed, olive, linseed, sesame, expressed oil of almonds, and liquid petrolatum. If the fixed oil is neutral and an alkali is to be used with it, the addition of a little oleic acid will aid in saponification and the soap formed will help to keep the ingredients mixed. Oil of turpentine is about the only volatile oil used as a base, although it and others are used for medicinal effect. The friction and massage with which liniments are applied are often beneficial. If a greater effect is desired, the part can be covered with waxed paper or woollen cloth. Liniments most frequently contain either soothing or stimulating medicines. Liniments should be labeled "For external use."

LINIMENTUM CHAMPHORAE U.S.P. Camphor Liniment (Lin. Camph.--Camphorated Oil)

Camphor Liniment contains, in each 100 Gm., not less than 19 per cent and not more than 21 per cent of camphor.

Caution--This preparation is not intended for hypodermic use.

Camphor, in coarse powder.	200 Gm.
Cottonseed Oil.	800 Gm.
To make.	1000 Gm.

Pour the cottonseed oil into a suitable dry flask or bottle, heat it on a water bath, add the camphor, and stopper the container securely. Dissolve the camphor by agitation without the further application of heat.

This liniment should never be made in an open dish, as much of the camphor will be volatilized.

The heat directed aids the solution of camphor. As no heat is applied after adding the camphor, the bottle can be stoppered tightly to prevent loss of camphor. Camphor will dissolve much more quickly if it is finely broken up. The container used in making it should not contain water or moisture. Winter-filtered oil should be used so that there will be no precipitation on standing or on chilling the liniment.

Storage--Preserve Camphor Liniment in well-closed containers.

Uses---A mild counter-irritant for inflamed joints, sprains, rheumatism, and in other inflamed conditions, such as colds in throat and chest, in infants and children.

Although the synonym "camphorated oil" is often applied to this liniment, the term is also frequently used by physicians to indicate a sterile, ten per cent solution of camphor in olive or other fixed oil. This is used hypodermatically as a stimulant. The two products must not be confused.

LINIMENTUM CAMPHORAE ET SAPONIS U.S.P. Camphor and Soap Liniment.

(Lin. Camph. et Sapon.--Linimentum Saponis, U.S.P. X; Soap Liniment; Liquid Opodeldoc; Camphorated Tincture of Soap)

Hard Soap, dried and granulated, or powdered.	60 Gm.
Camphor, in small pieces.	45 Gm.
Oil of Rosemary.	10 cc.
Alcohol.	700 cc.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Dissolve the camphor and the oil of rosemary in the alcohol, add the soap, and then sufficient distilled water to make the product measure 1000 cc. Agitate the mixture until the soap is dissolved, set it aside in a cool place for twenty-four hours, and filter.

Pure soap made from vegetable oil should be used, as it is purer sodium oleate and contains less sodium stearate and palmitate than soap made from animal fat. The mixture is set aside for twenty-four hours in order to allow precipitation of any stearate and palmitate, which are less soluble. Any excess of sodium oleate will also be precipitated. It is better to filter at a low temperature so that if the liniment should become chilled, it will not precipitate. In bar soap the amount of water varies greatly, consequently it is not as good as the dried, granulated or powdered soap in which the water is more constant, and which makes a more constant soap-content in the finished product. In making this preparation, time can be saved by following the directions given in the U.S.P. VIII in which the soap is dissolved in 200 cc. of boiling water and heat continued until a gelatinous mass is formed; while still warm part of the alcohol is added and later the oil and camphor dissolved in the balance of alcohol and then water to make the right amount. Sometimes, if care is not used, some alcohol is evaporated and the finished product will not make a homogeneous solution with chloroform. This liniment is sometimes used as a vehicle for other liniments.

Alcohol Content---From 62 to 66 per cent, by volume, of C_2H_5OH .

USP Preparation---Linimentum Chloroformi.

N.F. Preparation--Linimentum Aconiti et Chloroformi.

Storage--Preserve Camphor and Soap Liniment in well-closed containers.

Uses--An anodyne and mild rubefacient, for sprains, bruises, and rheumatism. It also forms the basis for other liniments.

LINIMENTUM CHLOROFORMI U.S.P. Chloroform Liniment
(Lin. Chlorof.)

Chloroform Liniment contains, at 25° C., in each 100 cc., not less than 40 Gm. and not more than 45 Gm. of Chloroform.

Chloroform	300 cc.
Camphor and Soap Liniment	700 cc.
To make	1000 cc.

Mix them by agitation.

Caution--Chloroform Liniment deteriorates with age.

Alcohol content--From 43 to 47 per cent, by volume, of C₂H₅OH.

Storage--Preserve Chloroform Liniment in well-closed containers.

Uses--A stimulating liniment for sore and stiff muscles, and a local anesthetic in neuralgia.

In making chloroform liniment it sometimes separates into two layers. This is due to the use of too much water in making soap liniment, or the evaporation of alcohol. If the soap liniment is properly made, it contains enough alcohol to enable it to mix clear with chloroform. In mixing the chloroform and soap liniment, there is contraction in volume so that in mixing 30 cc. of the former with 70 cc. of the latter, the mixture only measures about 96 cc.

LINIMENTUM SAPONIS MOLLIIS U.S.P. Liniment of Soft Soap
(Lin. Sapon. Moll.--Tincture of Green Soap: Tinctura Saponis Viridis)

Soft Soap	650 Gm.
Oil of Lavender	20 cc.
Alcohol, a sufficient quantity,	
To make	1000 cc.

Mix the oil of lavender with 300 cc. of alcohol, dissolve in this the soft soap by stirring or by agitation, and set the solution aside for twenty-four hours. Then filter it through paper, adding sufficient alcohol to make the product measure 1000 cc.

All solutions containing soap should be allowed to stand some time before filtering. There seems to be a slow continuous precipitation for weeks.

Alcohol Content--From 28 to 32 per cent, by volume, of C_2H_5OH .

Uses--Used largely as a soap for cleansing the area for an operation, also for washing the surgeon's hands, for washing the scalp, and for other detergent purposes.

The limit of free alkali in the soft soap should be carefully maintained, a small amount being helpful for antiseptic and cleansing purposes, but an excess rendering the soft soap caustic.

LINIMENTUM CALAMINAE N.F. Calamine Liniment
(Lin. Calam.)

Prepared Calamine.	80 Gm.
Zinc Oxide.	80 Gm.
Olive Oil.500 cc.
Solution of Calcium Hydroxide, a sufficient quantity,	
To make.	<u>1000 cc.</u>

Mix the prepared calamine and zinc oxide with the olive oil and gradually add the solution of calcium hydroxide, with constant agitation.

Shake the liniment thoroughly before dispensing.

The calcium hydroxide reacts slowly with olein in olive oil, forming soap, which helps to keep calamine and zinc oxide suspended.

Uses--In skin diseases.

LINIMENTUM CALCIS N.F. Lime Liniment
(Lin. Calc.--Carron Oil)

Solution of Calcium Hydroxide.	500 cc.
Linseed Oil.	<u>500 cc.</u>
To make.	1000 cc.

Mix them by agitation.

A chemical reaction takes place between the calcium hydroxide in lime water and the linolein in linseed oil. Calcium hydroxide and linolein give a small amount of calcium linoleate and glycerin. Calcium linoleate is a form of soap and helps to keep the balance of oil and water mixed. This liniment gets thicker with age, because of the gradual formation of soap. The lime water should be fresh and in this condition contains about 0.14 per cent of calcium hydroxide. If all of the calcium hydroxide were converted into calcium linoleate, there would be about 56 grams of soap in 1 liter of liniment. This is an example of "water-in-oil" emulsion.

Uses--A useful application to fresh burns and scalds. It restores the alkalinity to the burned area and excludes air, thus relieving the pain.

L I N I M E N T S

Definition:

Why are oily or alcoholic bases usually used for liniments?

What are embrocations?

In regard to use, how do liniments differ?

LINIMENTUM CAMPHORAE

C.M.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 100 Gms.

Requirement:

Formula:

State the U.S.P. "caution" and explain.

Uses.

Physical Properties.

LINIMENTUM CALPHORAE ET SAPONIS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

U.S.P. X Title:

Prepare 120 cc.

Formula:

What is "hard soap"?

Why must "hard soap, dried and granulated" be used in making this liniment?

Why is the mixture allowed to stand 24 hours in a cool place before filtering?

Give title of a U.S.P. preparation using this liniment.

Uses.

Physical Properties.

LINIMENTUM CHLOROFORMI

C.E.T. Abbr.

Prepare 120 cc.

Formula:

Caution.

Use.

LINIMENTUM SAPONIS MOLLIS

C.E.T. Abbr.

Syn.

Prepare 120 cc.

Formula:

Use.

Alcoholic Content.

LINIMENTUM CALAMINE

O.E.T. U.S.P. or N.F.

Prepare 120 cc.

Formula:

Method of compounding:

How does this preparation differ from calamine lotion?

LINIMENTUM CALCIS

O.E.T. U.S.P. or N.F.

Syn.

Prepare 120 cc.

Formula:

Why does this liniment get thick?

Uses:

COLLODIONS

Collodions are solutions of pyroxylin in a mixture of alcohol and ether, which mixture is a better solvent than either alone. Pyroxylin or gun cotton is made by treating purified cotton with a mixture of sulphuric and nitric acids, and is a mixture of several nitrates of cellulose. Probably, the di-, tri-, and tetra-nitrates make up the most of the official pyroxylin, and the penta- and hexa-nitrates are the explosive compounds. The lower nitrates are soluble in a mixture of alcohol and ether, also in acetone, acetic ether, or amyl acetate, while the higher nitrates are not. Collodion is inflammable and should be kept well protected from evaporation and from fire. It is incompatible with water or hydro-alcoholic solutions. Because of its great viscosity, chemicals dissolve very slowly in it. Collodion may be used alone or medicated. When the solvent has volatilized, there is left a thin membrane which is impervious to air and water and which contracts. Bottles containing collodion should be well-stoppered with cork stoppers, and after some has been poured out, the neck and mouth of the bottle should be wiped off to prevent the cork from sticking.

COLLODIUM FLEXILE U.S.P. Flexible Collodion (Collod. Flex.)

Camphor.	20 Gm.
Castor Oil.	30 Gm.
Collodion, a sufficient quantity,	
To make.	<hr/> 1000 cc.

Weigh the ingredients, successively, into a dry, tared bottle, stopper the bottle, and shake the mixture until the camphor is dissolved.

This is plain collodion with camphor and castor oil dissolved in it. It does not contract as much as plain collodion, and is not as stiff, but more flexible. It is used as the base for the N. F. collodions.

Alcohol Content--From 21 to 25 per cent, by volume, of C_2H_5OH .

N. F. Preparations--Collodium Salicylicum Compositum, Collodium Stypticum.

Storage--Preserve Flexible Collodion in well-closed containers, in a cool place, remote from fire.

Uses--Applied externally as a covering to cuts and small burns. Its application is accompanied by considerable pain, but is effective as an antiseptic and for excluding air from open wounds.

COLLODIUM SALICYLICUM COMPOSITUM N.F. Compound Salicylic Collodion (Collod. Salicyl. Co.--Corn Collodion)

Salicylic Acid.	10 Gm.
Fluidextract of Cannabis.	10 cc.
Flexible Collodion, a sufficient quantity,	
To make.	<hr/> 100 cc.

Dissolve the salicylic acid in about 75 cc. of flexible collodion, add the fluidextract of cannabis and sufficient flexible collodion to make the product measure 100 cc.

Storage--Keep the Collodion in well-closed containers, in a cool place.

Use--For the removal of corns. This is similar in composition to many of the liquid corn remedies on the market, though perhaps not quite as strong.

COLLODIUM STYPTICUM N.F. Styptic Collodion
(Collod. Stypt.)

Tannic Acid.	16 Gm.
Flexible Collodion, a sufficient quantity,	
To make.	<u>100 cc.</u>

Dissolve the tannic acid in about 80 cc. of flexible collodion and add sufficient flexible collodion to make the product measure 100 cc. Mix well.

Storage--Keep the Collodion in well-closed containers, in a cool place.

Uses--A styptic for small cuts.

COLLODIONS

Define:

What is pyroxylin and (briefly) how is it prepared?

Use.

Why should the neck of a collodion bottle be wiped off after pouring from it?

COLLODIUM STYPTICUM

O.E.T. U.S.P. or N.F.

Prepare 30 cc.

Formula:

Use:

COLLODIUM FLEXILE

C.E.T. U.S.P. or N.F.

Prepare 60 cc. Abbr.

Formula:

Use:

Storage:

COLLODIUM SALICYLICUM COMPOSITUM

C.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 30 cc.

Formula:

Is fluidextract of Cannabis on the narcotic register?

What is the synonym for Cannabis?

Use:

Storage:

INFUSIONS

Infusions are liquid preparations made by treating vegetable substances with either hot or cold water. The drug is not subjected to the boiling process, although it is common to pour boiling water over it; the mixture is allowed to stand in a closed vessel until cold. While the use of hot water has the advantage of saving time in some cases, it is often objectionable because the inert principles in the drug are dissolved by the hot water, and as the infusion cools, they are precipitated in such a very finely divided condition that they cannot be readily separated by collation or filtration. Cold water should be selected as the menstruum when the drug contains a valuable volatile principle, when the active agent is injured by heat, or when the desirable principles are readily soluble in water of ordinary temperature. The time required to make the infusion must also be considered, for in warm weather it is quite possible for an infusion to ferment or decompose before it is finished.

Pure water should be used in making infusions, and they should not be made in large quantities unless demanded for immediate use, as, without special precautions to preserve them, they soon decompose.

Of the inert principles found in plants, starch is extracted by hot water and albumen by cold water, while gum, sugar, and extractive are dissolved by both.

In making infusions the drug is usually coarsely comminuted, sliced, or bruised. Very fine powders should be avoided because it is difficult to separate the fine particles from the infusion and if percolation is resorted to, so much time is consumed in the operation, owing to the swelling of the powder, that decomposition may set in before the preparation is finished. Infusions are usually made by one of the following methods: 1. By maceration. 2. By digestion. 3. By percolation. 4. By diluting concentrated preparations.

1. BY MACERATION--This is the process which is most frequently used. The general formula of the U.S. Pharmacopoeia, which is here appended, furnishes a model.

OFFICIAL GENERAL PROCESS FOR INFUSIONS INFUSA, U.S.P. Infusion

An infusion may be dispensed only if it has been recently prepared. If the drug concentration of an infusion is not otherwise specified, it is to be prepared according to the following general formula:

The Drug, coarsely comminuted.	50 Gm.
Distilled Water, a sufficient quantity,	
To make.	1000 cc.

Moisten the drug in a suitable vessel, preferably of earthenware and provided with a cover with 50 cc. of cold distilled water and allow it to stand for fifteen minutes. Then add 900 cc. of boiling distilled water, cover the vessel tightly, and allow it to stand for half an hour. Then strain the mixture and pass enough distilled water through the strainer to make the Infusion measure 1000 cc. If the activity of the Infusion is affected by the temperature of boiling water, cold distilled water only should be used.

Caution--The drug concentration of an infusion representing a potent drug should be specified by the physician.

A very convenient and quite inexpensive apparatus may be made by the pharmacist, by selecting a queen's-ware or porcelain tea or coffee-pot, and if a hole is drilled through the top close to the handle, and made to terminate in a hook. The material to be infused is loosely tied up in a square piece of cheesecloth (coarse, thin muslin) and suspended from the hook; the hot water dissolves out the soluble principles by circulatory displacement. This method has the great advantage that no further straining is needed, as the bag retains the marc. The bag may be pressed and the contents then thrown away.

Some drugs are now supplied in accurately weighed amounts in muslin bags ready for the making of specific amounts of infusion. This is especially applied to digitalis and also to the preparation of tea as a beverage.

2. BY DIGESTION--The process of digestion consists in subjecting the substance to the continued action of moderate heat below the boiling temperature. In making infusions, digestion is often very useful, although it may not be directed in the formula. It generally suffices to place the infusion vessel upon a moderately hot portion of the stove plate, or near some other source of heat.

3. BY PERCOLATION--This method of making infusions is by far the most satisfactory and should be used whenever possible. It should be selected when the desirable principles are easily dissolved in water, and when the amount of menstruum is amply sufficient to exhaust the drug thoroughly. Percolation presents the advantages of furnishing a finished preparation, straining being unnecessary. Again, precipitation from the deposition of inert principles after the infusion has been strained, due to the principles being soluble in hot water but insoluble in cold water, is avoided. The chief drawback to the adoption of percolation in making infusions is the difficulty of maintaining heat when that is desirable and the length of time required to exhaust the drug with water. Infusions are generally extemporaneous preparations, and they are frequently desired quickly; hence the process of maceration is often selected in preference.

4. INFUSIONS FROM CONCENTRATED PREPARATIONS--The habit of making infusions from concentrated alcoholic tinctures or fluidextracts is improper and unjustifiable, except in those few cases in which the active and desirable principles of the drug are equally

soluble in alcohol and in water or in the menstrua used for both fluidextract and infusion. This is well illustrated in those preparations in which the activity of the drug is due to resinous bodies. Alcoholic menstrua here are necessary to dissolve the resins, and if such a fluidextract is added to water, precipitation takes place and the filtered infusion is worthless. If the precipitate is inert or does not carry down with it any portion of the active principle, and is readily separated, the only objection to the infusion is the presence of the alcohol, which may or may not seriously interfere with the therapeutic action, according to whether the quantity present is large or small. The saving in time and labor by making infusions in this way is the cause of the frequent employment of this method, but it should never be used if the therapeutic action of the drug is weakened thereby. The substitution of a fluidextract made infusion in a prescription for one directed to be made by an official process is reprehensible and inexcusable.

PRESERVATION OF INFUSIONS--The difficulty in preserving infusions arises from the decomposition of fermentable principles which are extracted and retained in the preparation. If sufficient alcohol is added to prevent decomposition, the therapeutic action of the infusion is usually interfered with, owing to the comparatively large proportion of spirit contained in the dose. Alcohol is successfully used in preparations like infusion of gentian, orange peel, etc., or tonics. If an antiseptic, like boric acid, salicylic acid, sodium benzoate, or phenol is used, the same objection exists--the interference due to the therapeutic action of the antiseptic.

It has been proved that infusions may be preserved for a long time if they are protected from the microscopic organisms which float in the air (see Sterilization). A simple method is to heat the infusion gradually, in a flask of hard glass, to the boiling point in order to destroy any organisms that may be present and then to transfer it at once, under proper precautions, to small bottles, which have been sterilized, filling them to the brim; the sterilized stoppers are then forced in and tied over, and the stoppers, lip, and neck of each bottle dipped into hot paraffin or sealing wax.

DECOCTIONS

Decoctions are liquid preparations made by boiling vegetable substances with water. The object sought in preparing decoctions is to secure, in aqueous solution, the soluble active principles of drugs which are not injured by heat. It is obvious that very few drugs are suited to this form of administration, and decoctions are rapidly declining in favor. Hot infusion will generally afford a means of obtaining all the benefits that are derived from boiling the drug with water, while the prolonged action of boiling water generally exercises a dissociating effect upon the active principles. The disadvantages of hot infusions are possessed in a more marked degree by decoctions. In compound decoctions the ingredients are preferably added at different periods of the operation, the hard, ligneous drugs being added first, and the aromatics

or those containing volatile oils, at the close of the process, so that loss of activity of the latter may not ensue.

The earthenware or porcelain vessels used in preparing infusions are preferred for decoctions, as they will bear the heat of boiling water, if heated gradually. The empyreumatic odor which many decoctions possess when made over a naked fire, and caused by particles adhering to the bottom of the vessel and becoming charred, is avoided by the use of the water bath.

The use of iron vessels is not advisable, because of the discoloration which is caused by the tannin of astringent drugs reacting with the iron, but the white enameled double boilers are admirably suited for the making of decoctions if they have not been chipped.

A general formula for decoctions is given in the U.S.P. XI as follows:

DECOCTA. U.S.P. Decoctions.

A decoction may be dispensed only if it has been recently prepared. In case the drug concentration of a decoction is not otherwise specified, it is to be prepared in accordance with the following general formula:

The Drug, coarsely comminuted.	50 Gm.
Distilled Water, a sufficient quantity,	
To make.	<u>1000 cc.</u>

Place the drug in a suitable vessel provided with a cover, pour upon it 1000 cc. of cold distilled water, cover it well, and boil the mixture for fifteen minutes. Then allow it to cool to about 40° C., express, strain the expressed liquid, and pass enough cold distilled water through the strainer to make the product measure 1000 cc.

Caution--The drug concentration of a decoction representing a potent drug should be specified by the physician.

EXTRACTA--Extracts

Extracts are either pasty or semi-solid masses, or dry, solid or powdered products, prepared by exhausting drugs with appropriate solvents, carefully evaporating the solutions so obtained to the prescribed consistence and adjusting the products to the fixed standards. An extract is intended to preserve the useful constituents of the drug in a concentrated, relatively uniform, permanent condition, and in a form suitable for medication.

The solvent or menstruum to be employed in the preparation of an extract is dependent upon the physical characteristics of the

drug and the nature of its constituents. The solvents commonly adopted are water or alcohol, or mixtures of these, in the proportions directed in the formulas. For the extraction of a few drugs, the addition of an acid or an alkali to the solvent is required.

The menstruum chosen for preparing an extract may be more strongly alcoholic than that for preparing the corresponding fluid-extract or tincture; this is to reduce the extraction of inert material in the drug by which the extract would otherwise be unduly diluted. In the manufacture of powdered extracts, the use of more strongly alcoholic menstrua also reduces extraction of the sugars and produces more satisfactory powders.

In the manufacture of extracts the drugs are extracted by the process of percolation. The entire percolates are concentrated by distillation under reduced pressure, with a few exceptions, in order to expose the drug principles to as little heat as possible. If the active principles of a drug are damaged by high temperatures or by prolonged heating, the temperature at which its percolate is concentrated is not to exceed 60° C., at any stage. In preparing extract of glycyrrhiza, a temperature of 100° C. is desirable to eliminate material of an albuminous nature.

When alcohol is used as a solvent, it may be recovered by distillation. When a drug contains an oily constituent that is extracted by the menstruum, it becomes necessary to adopt in the process of manufacture some method for the separation of this oil so that a permanent product of the proper consistence, dryness, or powdered form may be obtained.

The Pharmacopoeia permits any suitable method for defatting either the drug or the extract. The following methods of treating the extract are recommended:

Method 1--Prepare the extract in the regular manner to the point where, before final adjustment, it is dried with a portion of starch. To this dry powder add purified petroleum benzin (about 300 cc. of benzin for each 100 Gm. of drug extracted) and stir well several times during two hours. Allow to settle and decant or drain off the excess of liquid. Mix the residue with another (smaller) portion of purified petroleum benzin, stir thoroughly, and separate the excess of benzin. Repeat the washing with a third portion of purified petroleum benzin, then drain the powder, and dry it thoroughly at a temperature not exceeding 70° C. Weigh the dried powder and adjust it to the prescribed quantity or strength.

Method 11--To the soft extract obtained by the evaporation of the percolate add slightly acidulated water at a temperature of about 80° C. in the proportion of about 80 cc. of acidulated water to each 100 Gm. of drug. Stir the mixture thoroughly and allow it to stand until almost cold. Remove and discard any oily or fatty matter which has risen, then separate and retain the aqueous liquid. Treat the undissolved extract residue twice as just described, and combine and evaporate the aqueous liquids to a soft extract at a temperature not exceeding 70° C. Mix the soft extract thus obtained

with a portion of starch, dry the mixture at a temperature not exceeding 70° C., and complete the extract in the usual way.

The acidulated water suggested above should contain about 0.05 per cent of hydrochloric acid or about 0.2 per cent of tartaric acid.

The proximate principles most commonly present in extracts are gum, sugar, starch, tannin, extractive, chlorophyll, coloring-matter, inorganic salts, and the active principles of plants, to which when a spiritous solvent is employed, may usually be added, resinous substances, fatty matter, and frequently more or less volatile oil, gum and starch being excluded when the menstruum is strong alcohol. Inert fixed oil or fat is often removed from powdered drugs by previous percolation with ether or with petroleum benzin; these liquids do not, as a rule, extract the active principles, and thus a dry powdered extract can be made.

In the preparation of extracts, the concentration of the liquid extractions is to be completed without delay, and undue exposure to heat must be avoided. The limit of temperature for the evaporation, as stated in the formulas, should not be exceeded. In the manufacture of extracts on a large scale, apparatus for distilling and evaporating under reduced pressure should be used. It is also important that the residue be frequently stirred in order to hasten the evaporation and to obtain a uniformly smooth product.

In addition to extracts made by extracting drugs, sometimes the juices of fresh plants extracted by contusion and expression are evaporated, and such extracts are frequently called succi spissati, or inspissated juices.

EXTRACTIVE--It has long been known that in most vegetable bodies there is a substance, soluble both in water and in alcohol, which, in the preparation of extracts, undergoes chemical change during the process of evaporation or aging, imparting to the liquid, even if originally limpid, first, a greenish, then a yellowish-brown and ultimately a deep brown or almost black color, and becoming itself insoluble. This substance has frequently been spoken of as extractive, derived from its frequent presence in extracts. The most important property of extractive is its disposition to become insoluble under the influence of atmospheric air at a high temperature. If a vegetable infusion or decoction is evaporated in the open air to the consistence of an extract, then diluted, filtered, and again evaporated, and the process repeated so long as any insoluble matter is formed, the whole of the extractive will be separated from the liquid, while the other ingredients may remain. If chlorine is passed through an infusion or decoction, a similar precipitate is formed with much greater rapidity. The change is usually ascribed to the absorption of oxygen by the extractive, which has, therefore, been called, in its altered condition, oxidized extractive; but some authorities ascertained that, though oxygen is absorbed during the process, an equal measure of carbonic acid gas is given out, and the oxygen and hydrogen of the extractive unite to form water in such a

manner as to leave the principle richer in carbon than it was originally. The name of oxidized extractive is, therefore, obviously incorrect; and others long ago proposed to substitute for it that of apothem, synonymous with deposit. Apothem is not completely insoluble in water, but imparts a slight color to that liquid when cold, and is rather more soluble in boiling water, which becomes turbid upon cooling. It is still more soluble in alcohol, and is freely dissolved by solutions of the alkalies and alkaline carbonates, from which it is precipitated by acids. It has a great tendency, when precipitated from solutions, to unite with other principles and to carry them along with it, thus acquiring properties somewhat different, according to the source from which it is obtained. In this way, also, even when the extractive or a plant is itself medicinally inert its conversion into apothem may be injurious by causing a precipitation of a portion of the active principle; in practical pharmaceutical operations this change should always, if possible, be avoided.

VARIABLE QUALITY OF EXTRACTS---It is evident that there must be great variation in the quality of extracts of pilular consistence as found in commerce, for whether made by any of the processes commonly employed, or by a special patented process, the lack of a fixed standard to determine the amount of moisture which is to remain in pilular extracts renders them very variable in strength. The Pharmacopoeia is necessarily compelled to avoid specifying an exact limit in this respect, and the approximate standard of pilular consistence has been adopted. The powdered extracts are more stable and being adjusted through the addition of a diluent to an exact weight, they have a great advantage over pilular extracts. It should be said in addition that the variation in the strength of extracts of pilular consistence does not cease even after their manufacture. The exposure to the air to which they are subjected in dispensing, particularly if kept in the customary open queen's-ware or glass jars, causes loss of moisture and they become hard, and consequently stronger, in proportion to the quantity of moisture that is thus lost; this loss may in some cases amount to as much as 25 per cent. In moist climates, however, some extracts absorb moisture and become thinner. One of the advantages of powdered extracts is that they may be kept in tightly corked vials, and thus protected from moisture. The greatest variation in the commercial extracts, however, arises from the difference in the alcoholic strength of the menstruum employed. This may be best illustrated by taking the case of extract of jalap. Alcohol dissolves the active principles of jalap, while water is the best solvent for those that are inert. If a manufacturer in making extract of jalap uses equal parts of alcohol and water, he will obtain twice as much extract as the manufacturer who simply uses alcohol; but the alcohol extract or resin has twice the strength of the hydro-alcoholic extract, and is worth double the price, because it has been shown that the aqueous extract of jalap is absolutely inert even in doses of 240 grains. The difference between the relative merits of alcoholic and aqueous extracts does not so clearly appear in many of the extracts as in the instance just noted, but it is shown in such important extracts as those from belladonna, hyoscyamus, digitalis, etc, for the strength of these depends largely upon the menstrua used in exhausting them, water removing the inert prin-

ciples, starch, gum, albumen, sugar, salt, etc. The relative value of commercial extracts must depend upon the amount of active principles present. When an extract is official, the menstruum directed should be employed and no other. The U.S.P. XI permits the replacement of ethyl alcohol by specially denatured alcohol through the following provision.

"In the manufacture of pharmacopoeial extracts and resins in which alcohol is used as a solvent only and does not remain in the finished product, it is permissible that alcohol made non-potable by the addition of from 5 to 10 per cent by volume of commercially pure methanol or acetone be used in the place of ethyl alcohol in accordance with Federal Statutes and Regulations of the Bureau of Internal Revenue, but the extracts and resins so made must be identical with those prepared by the processes in the monographs and must conform to the standards fixed by the tests of the U. S. Pharmacopoeia, Eleventh."

It is now common practice for manufacturers to indicate on the labels of extracts not amenable to assay, the yield of the extract in relation to the drug from which it was prepared. Commercial extracts from most drugs will run from 1 to 4, to 1 to 6, i.e., 1 pound of extract represents 4, or 5, or 6 parts of drug, but some drugs yield so great a proportion of extractive matter that their extracts run only 1 to 2 or 1 to 3. As examples might be mentioned solid extract of gentian, 1 to 2, and powdered extract of cascara sagrada, 1 to 3.

PREPARATION OF EXTRACTS--The manipulations necessary to produce extracts have been considered under the various heads of Maceration, Expression, Percolation, Decoction, Infusion, Evaporation, etc.

PRESERVATION OF EXTRACTS--Special care in the preservation of pilular extracts is rarely taken. This arises from the incorrect impression that they are permanent preparations and do not need it. The manufacturers seal the jars or bottles which contain them, because experience has compelled them to be very careful to avoid loss in transportation. The loosely fitting covers often used for the jars permit exposure which causes the variation noted, and it is impracticable for the pharmacist on every occasion to seal the jar immediately after he has used a portion of the extract. Several expedients have been suggested to overcome these difficulties. It is good practice to enclose the jar in a tightly fitting can, or to put the extract in a jar with a cover which clamps down tightly and is fitted with a thin cork disk in the top to aid in making a tight joint; many manufacturers are now marketing pilular extracts in jars fitted with covers of this character and several are using collapsible tin tubes to prevent evaporation or absorption of moisture.

STORAGE--Preserve Extracts in well-closed containers, in a cool place and protected from strong light.

PILULAR EXTRACTS--The plastic or semi-solid extracts are designated "pilular extracts" because they were extensively used in pill masses. They are used in ointments, and suppositories, and to facilitate their use in these preparations, the degree of concentration is directed to be that of a "pilular consistence." In these, an excess of moisture is to be avoided and the proper pliability and consistence may be maintained by the addition of a small amount of glucose or glycerin.

POWDERED EXTRACTS--Powdered extracts differ from pilular extracts in that they are dry and prepared either as fine or granular powders. They are more generally used than pilular extracts because they can be more accurately weighed, more easily dispensed, and more conveniently preserved. The difficulty in making them arises from the injurious influence of heat upon concentrated percolates of organic substances, but by the use of vacuum apparatus, suitable absorptive diluents, and care, they can be made successfully. The limit of temperature as stated in the formulas should not be exceeded, and final drying of the soft extract can be greatly facilitated by spreading it upon plates of glass or tinned metal and exposing it to currents of warm, dry air, if vacuum apparatus is not available.

In the preparation of powdered extracts it is necessary to use solvents that will extract the active principles of the drugs, and only a minimum amount of the inert substances. If the drug contains an oily constituent this must be removed as already indicated so that the product will retain a satisfactory powdered form.

ASSAYING EXTRACTS--Extracts which must be adjusted to prescribed standards may need diluents for that purpose. While in the Pharmacopoeia glucose is directed as the diluent for pilular extracts, and starch, dried at 100° C., for powdered extracts, the following additional diluents are permitted; malt extracts for pilular extracts, and, for powdered extracts, sucrose, lactose, powdered glycyrrhiza, magnesium carbonate, magnesium oxide, calcium phosphate or the finely powdered marc remaining after the extraction of the drug. The diluents, added to the powdered extracts, may be colored with chlorophyll or caramel to produce a color corresponding to the normal color of the extract, but an excess of color must not be added.

For the convenience of the prescriber, the standards of strength for the extracts have been adjusted wherever possible, so that each bears a definite relation to that of the respective drug of average strength. A statement of the standard adopted accompanies each formula.

INSPISSATED JUICES--The variation in the amount of extractive matter afforded by expressing fresh plants is so great that the quality of this class of extracts is necessarily very uncertain. Although alcoholic extracts are also subject to variations, experience has shown that they are much more reliable, when properly made,

than extracts prepared from expressed juices. For this reason inspissated juices are not recognized in the U. S. Pharmacopoeia.

POWDERS

The preparations considered under this title are the official compound powders. They consist of intimate mixtures of substances which, in the majority of instances, have previously been reduced to a fine powder. Because some substances, especially those containing aromatic volatile oils, would be injured by preliminary powdering, these are usually mixed without grinding and the mixture reduced to a fine powder. They therefore call for a consideration of many of the principles and much of the apparatus described under Comminution and Trituration.

ADVANTAGES. The giving of medicines in the form of powders is advantageous in case of children or other persons who have difficulty in swallowing pills or capsules. Powders are more easily carried by persons who are traveling or are so engaged that liquids are not convenient. Heavy metallic salts and other insoluble compounds sometimes act better when given in the form of powders. Because of the fineness of the particles, powders sometimes are readily absorbed and act differently from solutions. The taste may be less disagreeable in the form of powders than in solution. There is less danger of chemical reaction when agents are mixed dry than when mixed with water, but reaction may take place in a comparatively short time, as when all of the ingredients of a Seidlitz powder are mixed, or more slowly (requiring several months) in case of aspirin with quinine.

DISADVANTAGES. Not all solids are suited for giving in the form of powders. Some absorb moisture from the air, as potassium acetate. Some give off water of crystallization, as sodium phosphate. Some are oxidized in the air, as ferrous sulphate. Some cause explosion when rubbed together, as potassium chlorate with organic matter. Some make a mass or liquid when rubbed together because of liberation of water of crystallization brought about by chemical reaction, as lead acetate with zinc sulphate. Some liquefy, because of new liquid products formed, as camphor with thymol. The latter are called eutectic mixtures and are likened to alloys in that the melting point of the mixture is below that of either ingredient. This trouble is quite often experienced with mixtures containing menthol, camphor, phenol, chloral hydrate, euphorin, resorcin, salol and several other organic chemicals. Sometimes mixtures of any two or three compounds will not liquefy while all three together will. These may sometimes be dried with starch or dispensed in capsules.

MIXING. Before mixing the ingredients of a powder, each one should be in a fine state of subdivision, unless where one is gritty and will help to powder the others, as in making U.S.P. Dover's powder. In powdering a substance frequent sifting to remove the fine powder which protects the coarse particles will hasten the process. Sometimes substances like acetanilid, rosin or oil of theobroma, become electrified on being triturated; this can be over-

come by dampening with a little alcohol or ether. If small amounts of ingredients are to be mixed, it is best done in a mortar, but larger amounts can be mixed on paper, and still larger amounts in a powder sifter and mixer. All powders are more thoroughly mixed by passing through a sieve. If a powder is to be given by insufflation or applied as a dusting powder, it should be passed through a sieve, or better still, a bolting cloth of 150 to 200 mesh, to make it light and fluffy, as rubbing in a mortar makes it dense and heavy. In mixing a small amount of active agent with a large amount of a comparatively inactive agent, the stronger should be thoroughly mixed with a small portion of the inactive agent (e.g., sugar of milk), and then with further portions. By so doing the mixture will be more perfect. The same principle holds true in making ointments or other mixtures.

DIVIDING. Various forms of mechanical appliances have been made to divide a powder into a given number of equal portions. These may be of service when the amount in a dose is large, but when the dose is a few grains or less the powder can best be divided by forming it into a square or rectangle on a pill tile, and, with a spatula, dividing into the required number of doses. With a little practice this can be done with accuracy. If a fraction of a grain of an active agent is wanted, as $1/8$ of a grain, 1 grain of the active agent and 7 grains of milk sugar can be triturated together and then one grain of this mixture taken, or a tablet triturate or hypodermic tablet containing $1/8$ grain of the agent may be taken.

DISPENSING. Powders divided into doses are generally dispensed in well-calendered papers or capsules. If a powder is likely to change in air, it should be wrapped in waxed or paraffined paper. If only three or four powders are to be dispensed at a time, they are best put into an envelope, but if more, they should be put into a box. They should be folded so that the length will be the same as the inside length of the box and the width the same as the depth of the box, and they should be of uniform size. In folding powder papers, it is customary to first crease them near one side, creasing several at one operation. These papers are then distributed on the table with the crease and flap away from the operator. The requisite amount of powder is transferred to the center of each paper. The edge of the paper nearest the operator is carried over to the crease and the flap pressed down. A fold is made so that the width of the package will be the depth of the box container. The ends are folded away from the flap to prevent buckling and consequent loss of powder. The ends may be folded over the box, pressing in the ends of the box so that the length of the package will correspond with the inside length of the box, or the papers may be folded over a regular powder folder. If the powder is to be dispensed in bulk, it may be put into a box, but if it changes in air it should be put into a wide-mouth bottle, a paper being laid over the mouth of the bottle before inserting the cork, so that particles of cork will not fall into the powder. Powders are usually taken by dropping on the back part of the tongue and then washing down with water. Sometimes they are first mixed with water in a tablespoon, or better, with syrup, because this is more viscid and will hold the powder in suspension.

Many people prefer taking a capsule to taking a powder and besides capsules have some other advantages. They are often more convenient. Bitter and disagreeable solids can be taken without being tasted. The powder is protected to some extent from the action of the air. Powders in capsules have the advantage over pills in that the powder is more readily absorbed than a dry, hard pill. Occasionally a pill mass is put into a capsule, because a larger amount can be taken. Capsules should be well wetted in the mouth and then swallowed with a drink of water. The size of the capsule is designated by a number. Number 5 is the smallest and 00 the largest used for humans. Veterinary capsules are still larger. The approximate capacity of empty capsules for several representative products is usually given on the small containers as sold by the manufacturer,

Some powders like quinine sulphate, can be easily filled into capsules by forcing the capsule into the crystalline powder, while others do not stick in the capsule and must be pushed in with a spatula.

PULVERES EFFERVESCENTES COMPOSITI U.S.P. Compound Effervescent Powders.

(Pulv. Eff. Co.--Pulvis Effervescens Compositus, U.S.P. X; Seidlitz Powders)

The mixture in a blue paper weighs not less than 9.5 Gm. and not more than 10.5 Gm., and contains not less than 23 per cent and not more than 27 per cent of NaHCO_3 , and not less than 73 per cent and not more than 78 per cent of $\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}$. The white paper contains not less than 2 Gm. and not more than 2.4 Gm. of $\text{H}_2\text{C}_4\text{H}_4\text{O}_5$.

Sodium Bicarbonate, dry and all passing through a No. 60 standard mesh sieve.	30 Gm.
Potassium and Sodium Tartrate, dry and all passing through a No. 60 standard mesh sieve.	90 Gm.
Tartaric Acid, dry and all passing through a No. 40 standard mesh sieve.	26 Gm.

Mix the sodium bicarbonate intimately with the potassium and sodium tartrate, divide the mixture into 12 equal parts, and wrap each part in a blue paper. Then divide the tartaric acid into 12 equal parts, and wrap each part in a white paper.

History--The name Seidlitz Powder was given to this preparation by the originator and patentee, Thomas Savory, in 1815. Although custom has established its use and its legality, the name is incorrect, as the patentee misrepresented when he claimed that the powders owed their value to the mineral properties of the Seidlitz Spring in Germany. The Seidlitz Spring owes its therapeutic properties to magnesium sulfate. The formula of this patent medicine for such it was at that time, was exposed in a book of recipes published by the Philadelphia College of Pharmacy in 1824.

Storage--Preserve Compound Effervescent Powders in well-closed containers and in a dry place.

Uses--These powders are aperient and refrigerant.

Average Dose--The contents of a white and of a blue paper dissolved separately in water, and the solution mixed.

PULVIS CRETAE COMPOSITUS. U.S.P. Compound Chalk Powder.
(Pulv. Cret. Co.)

Prepared Chalk.	30 Gm.
Acacia, in very fine powder.	20 Gm.
Sucrose, in fine powder.	50 Gm.
To make.	100 Gm.

Mix the powders intimately by trituration and pass the product through a No. 60 sieve.

U.S.P. Preparation--Mistura Cretae.

Uses--A convenient form for the administration of chalk as an antacid.

Average dose--2 Gm.

P O W D E R S

Definition:

List and define the four official grades of powders.

Why are not all solids suitable for administration in the form of powders?

Why in powdering a substance, should it be sifted occasionally?

Why is it best to dampen rosin and camphor with alcohol before powdering?

Explain the use of a tracer.

PULVIS CRETAE COMPOSITUS

O.E.T. U.S.P. or N.F.

Prepare 50 Gm.

Formula:

Divide 10 Gms. of powder into 10 equal parts and place in chartulae.

Use:

Dose:

PULVERES EFFERVESCENTES COMPOSITI

C.E.T. U.S.P. or N.F.

Prepare 12 powders.

Formula:

Use:

Dose:

Why are sodium bicarbonate and tartaric acid used in this preparation?

OINTMENTS

Ointments or salves are soft, fatty preparations intended for external application. The official formulas are given below.

PERMISSIBLE ALTERATION OF FORMULAS--The U.S.P. XI has authorized the modification of the official formulas under certain conditions. The statement is as follows: "In the official ointments and cerates, which contain yellow or white wax or paraffin as stiffening agents, the proportions of these and of the other fatty substances directed in the official formulas may be varied to maintain a suitable consistence under different climatic conditions, provided that the ratio of active ingredients to the total weight of the ointment or cerate remains the same and that the nature of the vehicle is not materially changed." A similar authorization is made in the National Formulary.

BASES. The agents most commonly used as ointment bases are petrolatum, lard, wool fat, sodium stearate, casein, and glycerite of starch. A mixture of petrolatum and wool fat may be used to get some properties of each. It may be necessary to harden petrolatum or lard, particularly for summer use, and to accomplish this there may be added paraffin, yellow wax, white wax, spermaceti, cersin, or rosin.

Petrolatum is a mixture of hydrocarbons obtained from petroleum by distilling off the more volatile and liquid portions, and deodorizing and decolorizing the residue. Petrolatum is not readily absorbed, and agents mixed with it are not readily absorbed, consequently it is good as a protective agent and for the application of antiseptics, but not good for systemic remedies. It does not become rancid or change quickly. It can be made to take up about 5 per cent of water, but the addition of 5 per cent of beeswax enables considerably more water to be taken up. When a watery or alcoholic preparation is to be mixed with petrolatum, the liquid can first be mixed with wool fat and then with petrolatum. It melts between 38° and 54° C., and should be free from acids or chemicals used in purifying it. In warm weather it may be stiffened by adding some paraffin or yellow wax. In most instances the U.S.P. gives the preference to the latter.

Wool fat is a complex mixture of which cholesterin is an important constituent. It is obtained from the washings of wool by treating with a weak alkali, washing with water, precipitating with calcium chloride, dehydrating, extracting with acetone, and evaporating the solvent. The anhydrous fat thus obtained is too stiff and sticky to be used alone as a base, but is mixed with water to make the hydrous wool fat which contains between 25 and 30 per cent of water. It will mix much more easily with water, if the fat is first warmed a little. Hydrous wool fat is somewhat sticky, but the addition of a little petrolatum will make it less so. Anhydrous wool fat melts between 38° and 42° C. It can be mixed with two or three times its weight of water and still retain its ointment-like properties; it is chiefly used in ointments where a large amount of liquid is to

be taken up. Hydrous wool fat does not readily become rancid. It will take up more than its weight of water. The claim is made that it is more readily absorbed than other ointment bases, and medicines mixed with it are more easily absorbed. Some writers have questioned this statement and say that it is not as easily absorbed as lard.

Lard consists mainly of olein, stearin, and almitin. The best is obtained in cold weather from the "leaves of the hog." It melts between 36° and 42° C., and should be free from salt, alkalies, and water. It soon becomes rancid, and in that condition is irritating to a tender or abraded skin, and besides it has a repulsive odor and may cause chemical reaction. Anhydrous lard keeps best, water tending to cause it to become rancid. Melted lard should be quickly chilled and stirred to prevent granulation. When lard or an ointment granulates, it is due to the separation of the ingredient having a high melting point from one having a low melting point. Lard can be made to take up from 15 to 20 per cent of water, but a small amount of alkali in it enables a much larger amount to be taken up. Hot weather may liquefy lard, and in such a case the U.S.P. allows the addition of 5 per cent of white wax. Paraffin is more liable to make the ointment more granular than wax. In the present Pharmacopoeia, lard is largely replaced by a mixture of petrolatum and wool fat, this mixture not becoming rancid and not granulating on keeping, as lard does.

Benzoinated lard is made by keeping benzoin in melted lard for two hours. Lard dissolves benzoic and cinnamic acids and volatile oil, all of which act as antiseptics, retarding rancidity. A temperature higher than 60° C. should not be used, because of danger of volatilizing the acids and oil. Lard may be benzoinated at the time of preparing. Some pharmacists benzoinate lard by adding tincture of benzoin and evaporating the alcohol, but this leaves an excess of resin. Others prefer to make a strong solution of benzoin in alcohol, add it to castor oil and evaporate off the alcohol and then add the oil to the lard. In its power of being absorbed, lard comes between petrolatum and wool fat, and nearer the latter. A mixture of petrolatum and wool fat may be made to simulate lard in its capability of being absorbed.

Sodium stearate and casein are used in the so-called greaseless or vanishing cold creams and massage preparations. Sodium stearate is made by reaction between sodium carbonate and commercial stearic acid, and it has the property of holding a large amount of water. Casein is obtained from milk by removing the fat and precipitating the casein with an acid. The process is tedious, and after the ointment is made it contracts and forces out some water. These preparations often leave the skin dry and hard.

Glycerite of starch has the advantage that it can be washed off with water, but it has the disadvantage that it absorbs water from the air and liquefies. It is not often used.

Paraffin is a mixture of hydrocarbons, having a little higher melting point than petrolatum, and obtained from the residue

after distilling off the more volatile products of petroleum. It melts at from 50° to 57° C. When paraffin is mixed with petrolatum or lard, the ointment is more likely to become granular than if wax were used. Yellow wax is preferable to white wax in making ointments because in the bleaching of the wax, it has been changed so that an ointment made with it is more likely to become rancid than if made with yellow wax. Yellow wax has quite a preserving effect although it has the disadvantage of making a more yellow product. Spermaceti is a fatty solid obtained from the head of the sperm whale. Its melting point is between 38° and 40° C. It should be free from rancidity although it is sometimes slightly rancid on account of a little oil having been left in. Cersin is much like paraffin and is obtained from ozokerite, a mineral wax. It melts between about 45° to 65° C. An ointment made with it is not so likely to become granular as with paraffin. Rosin is the residue left after distilling off the turpentine from the exudation of pine trees. It softens at 100° C. but requires a higher heat to melt it. When melted and mixed with lard, the mixture is quite homogenous so that it may be cooled without stirring, making a smooth product and free from granulation.

METHODS OF MAKING. Ointments are made by incorporation, by fusion, and one (nitrate of mercury) by chemical action. If the remedy to be incorporated is solid, it should first be reduced to an impalpable powder, a soft mass, or a solution, before mixing with the base. Sometimes it is better to rub the medicinal agent with a liquid in which it is insoluble, as water, oil, or a part of the melted base, before mixing with the balance of the base, as in making ointment of the yellow oxide of mercury. In such a case the liquid aids powdering and prevents reduction of a salt to the metallic state. If the medicinal agent is soluble and crystalline, it is not desirable, as a general rule, to dissolve it in water, as the water may vaporize, leaving the salt in gritty crystals. Solid extracts should be softened with water or dilute alcohol. Medicinal agents soluble in fats should be dissolved in a liquefied portion of the base. Free alkaloids are best rubbed with a oleic acid, which converts them into oleates. Agents which are likely to react with each other should be rubbed with separate portions of the base first. If a hard ointment is to be mixed with a softer one, the hard ointment should be warmed gently and well rubbed down before adding the softer one. If liquids are to be incorporated, they should be added in small portions, mixing well after each addition, or they should be taken up with some wool fat and then mixed with the base. If a large amount of powder is to be incorporated, part of the base should be melted and rubbed with the powder first, warming if necessary. Or the powder may be rubbed with some oil first. A very active agent should be mixed thoroughly with a small portion of the base and then with other portions.

The ingredients of an ointment are usually mixed on a glass slab with a spatula, although sometimes a mortar is preferred, particularly where a large amount of liquid is to be incorporated. In the case of agents, like iodine, mercury salts, and acids, that attack an iron spatula, use a rubber, horn, or wooden one.

When an ointment or ointment base is to be made by melting several agents together, the ingredient having the highest melting point should be melted first, and then the one having the next, so that the one having lower melting points will not be injured by heat. In most cases the heat of a water bath is sufficient. A mixture of agents having different solidifying points should generally be stirred while cooling to prevent granulation caused by the ingredient having the highest melting point solidifying first. If large amounts of ointments are to be mixed, a pony mixer is convenient. It can also be used in making toilet creams, tooth-paste and similar masses. Further stirring makes the ointment whiter, but incorporates air, which tends to make it become rancid. If water is to be incorporated with melted fats, the mixture must be stirred until cold.

In cleaning utensils, the greater part of the grease can best be wiped out with sawdust and then washed with soap and water. To remove the odor of iodoform, phenol, cresol, thymol or similar bodies from a mortar, wash the mortar with oil of turpentine or gasoline and then with soap and water, or pour in a little alcohol and set fire to it. Lead oleate and other metallic oleates are not readily removed by soap and must be dissolved first in some oil, ether, chloroform, or similar solvent.

KEEPING. Stock containers for ointments should be made of porcelain or glass, and should be thoroughly cleaned before putting in a fresh lot of ointment, because an old ointment will soon cause the new one to become rancid. The surface of china-ware containers becomes cracked, and grease gets in and becomes rancid and cannot be removed. An old ointment should not be mixed with a fresh one. Ointments should be kept in a cool, dry place and away from light. An ointment containing resorcin soon becomes brownish red on exposure to light and ointments containing salts of mercury darken because of the reduction of mercury. Sometimes ingredients, like oil of cade or balsam of Peru, separate on standing, and can best be held in mixture by rubbing with some wool fat first. Balsam of Peru with sulphur in the same ointment gives much trouble, forming sticky granules when rubbed on the skin. It is best to make up only a small amount of any ointment at a time so that it will be used up within a reasonable period.

UNGUENTUM, U.S.P. Ointment (Ung.--Simple Ointment)

Wool Fat.	5 Gm.
White Wax.	5 Gm.
White Petrolatum.	90 Gm.
To make.	100 Gm.

Melt the white wax in a suitable dish on a water bath, add the other ingredients, warm until they are liquefied, then discontinue the heating, and stir the mixture until it congeals.

U.S.P. Preparations--Unguentum Acidi Tannici; Unguentum Gallae.

N.F. Preparations--Unguentum Calaminae; Unguentum Hydrargyri Chloridi Mitis.

Uses--Emollient, also a vehicle for other ointments.

UNGUENTUM ACIDI BORICI. U.S.P. Boric Acid Ointment
(Ung. Acid. Bor.--Boracic Acid Ointment)

Ointment of Boric Acid contains not less than 9 per cent and not more than 11 per cent of H_3BO_3 .

Boric Acid, finely powdered.	10 Gm.
Wool Fat.	5 Gm.
White Wax.	5 Gm.
White Petrolatum.	80 Gm.
To make.	100 Gm.

Melt the white wax in a suitable dish on a water bath, add the wool fat and the white petrolatum, and heat the mixture gently until it is liquefied. Gradually add the warm liquid to the boric acid contained in a warm mortar, triturating thoroughly, and stir the mixture until it congeals.

UNGUENTUM ACIDI TANNICI. U.S.P. Tannic Acid Ointment.
(Ung. Acid Tan.)

Caution--During its manufacture and storage this ointment must not come in contact with iron utensils or containers.

Tannic Acid.	20 Gm.
Glycerin.	20 Gm.
Wool Fat.	3 Gm.
Yellow Wax.	3 Gm.
Petrolatum.	54 Gm.
To make.	100 Gm.

Dissolve the tannic acid in the glycerin with the aid of gentle heat. Melt the yellow wax on a water bath, add the wool fat and the petrolatum and gradually incorporate this warm liquid with the tannic acid solution.

Uses--An application for hemorrhoids.

UNGUENTUM CHRYSAROBINI. U.S.P. Chrysarobin Ointment
(Ung. Chrysarob.)

Chrysarobin.	6 Gm.
Wool Fat.	5 Gm.
Yellow Wax.	5 Gm.
Chloroform.	4 Gm.
Liquid Petrolatum.	6 Gm.
Petrolatum, a sufficient quantity,	
To make.	100 Gm.

Triturate the chrysarobin with the liquid petrolatum and the chloroform. Melt the wool fat, yellow wax and 50 Gm. of the petrolatum in a suitable dish on a water bath, and add this warm liquid to the chrysarobin mixture, triturating thoroughly. Finally incorporate sufficient petrolatum to make the finished product weigh 100 Gm.

Uses--An antiparasitic.

UNGUENTUM PICIS PINI. U.S.P. Pine Tar Ointment
(Ung. Pic. Pin.--Unguentum Picis Liquidæ)

Pine Tar.	50 Gm.
Yellow Wax.	15 Gm.
Petrolatum.	35 Gm.
To make about.	100 Gm.

Melt the yellow wax on a water bath, add the petrolatum, and to the melted mixture add the pine tar, previously warmed, and incorporate thoroughly. Strain the mixture through muslin, and stir it until it congeals.

Uses--A stimulant application.

UNGUENTUM SULFURIS. U.S. Sulfur Ointment
(Ung. Sulfur.)

Sulfur Ointment contains not less than 13.5 per cent and not more than 16.5 per cent of S.

Precipitated Sulfur.	15 Gm.
Wool Fat.	5 Gm.
Yellow Wax.	5 Gm.
White Petrolatum.	75 Gm.
To make.	100 Gm.

Melt the yellow wax in a suitable dish on a water bath, add the wool fat and the white petrolatum, and heat the mixture gently until it is liquefied. Gradually incorporate the warm liquid with the precipitated sulfur until a uniform mixture is obtained.

Uses--An antiparasitic.

UNGUENTUM ZINCI OXIDI. U.S. Zinc Oxide Ointment
(Ung. Zinc. Ox.--Zinc Ointment.)

Zinc Oxide Ointment contains not less than 19 per cent and not more than 21 per cent of ZnO.

Zinc Oxide, in very fine powder.	20 Gm.
Liquid Petrolatum.	10 Gm.
Wool Fat.	5 Gm.
White Wax.	5 Gm.
White Petrolatum.	60 Gm.
To make.	100 Gm.

Mix the wool fat and the liquid petrolatum, and thoroughly levigate the zinc oxide with this mixture. Melt together the white wax and white petrolatum, allow the mixture to cool until it becomes a soft mass, and then thoroughly incorporate the zinc oxide mixture.

Uses--A mildly antiseptic and astringent dressing.

UNGUENTUM ACIDI BENZOICI COMPOSITUM N.F. Compound Ointment of Benzoic Acid.

(Ung. Acid. Benz. Co.--WHITFIELD'S OINTMENT)

Benzoic Acid.	12 Gm.
Salicylic Acid.	6 Gm.
Wool Fat.	5 Gm.
White Petrolatum, a sufficient quantity,	
To make.	100 Gm.

Powder the acids very finely, and incorporate them with the wool fat and a portion of the petrolatum until a smooth, homogeneous mixture is obtained. Add the remainder of the petrolatum, and mix intimately.

NOTE--Compound Ointment of Benzoic Acid may be diluted by incorporating into the Ointment a sufficient quantity of white petrolatum to obtain the desired concentration. When diluted, it must be labeled "Not N.F.," and the concentration of the benzoic acid and the salicylic acid must be stated on the label.

Uses--For ringworm and especially for the dermatitis known as "athlete's foot."

UNGUENTUM ICHTHAMMOLIS. N.F. Ointment of Ichthammol
(Ung. Ichtham.--UNGUENTUM BITUMINIS SULPHONATI, N.F. V)

Ichthammol.	10 Gm.
Petrolatum.	90 Gm.
To make.	100 Gm.

Thoroughly incorporate the ichthammol with the petrolatum.

Uses--An antiseptic and emollient.

UNGUENTUM MENTHOLIS COMPOSITUM. N.F. Compound Ointment of Menthol.
(Ung. Menthol. Co.--Inunctum Mentholis Compositum, N.F. V)

Menthol.	15 Gm.
Methyl Salicylate.	10 Gm.
White Wax.	5 Gm.
Hydrous Wool Fat.	70 Gm.
To make.	100 Gm.

Melt the white wax with the hydrous wool fat on a water bath. Dissolve the menthol in the methyl salicylate, add it to the melted mixture, and stir until it congeals.

Storage--Keep the Ointment in collapsible metal tubes, well-sealed or in small, tightly stoppered, wide-mouthed containers.

Uses--This type of preparation is often sold under the name Analgesic Balm. It is intended to allay pain.

O I N T M E N T S

Definition:

List the generally used ointment bases (including substances used to raise the M. P. of ointments), the source and melting point of each.

By what three methods are ointments made?

Compare the advantages and disadvantages of Lard, Wool fat, Petro-latum.

What type of wool fat is on the Medical Department Supply Table?

Give the general precautions to observe in dispensing and storing ointments as a class.

Why should an ointment base be free from rancidity?

UNGUENTUM ACILI PORICI

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Requirement:

Prepare 50 Gm.

Formula:

Why is the wax melted before adding the wool fat and white petrolatum?

Uses.

Storage.

Description and physical properties.

UNGUENTUM SULFURIS

O.E.T. U.S.P. or N.F.
Syn. Abbr.

Requirement:

Prepare 30 Gms.

Formula:

What forms of sulfur are official?

In what other base may sulfur be applied externally and what are its advantages?

What caution must be taken in the preparation of this ointment.

UNGUENTUM ACIDI TANNICI

O.E.T. U.S.P. or N.F.

Abbr.

Prepare 30 Gm.

Formula:

Why is glycerin used in this preparation?

Why is an iron spatula not used in preparing this ointment?

Uses.

UNGUENTUM CHRYSAROBINI

O.E.T. U.S.P. or N.F.

Abbr.

Prepare 30 Gm.

Formula:

Why is heat used in preparing this ointment?

Uses.

UNGUENTUM PICIS PINI

C.E.T. U.S.P. or N.F.

Abbr.

Prepare 30 Gm:

Formula:

Why should this ointment not be heated too much?

Uses.

UNGUENTUM ZINCI OXIDI

C.E.T. U.S.P. or N.F.

Abbr.

Prepare 30 Gm.

Formula:

Uses.

UNGUENTUM BENZOICI COMPOSITUM.

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 30 Gm:

Formula:

Use:

What is the "Note" on this preparation?

UNGUENTUM ICHTHAMMOLIS

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 30 Gm.

Formula:

Uses.

UNGUENTUM MENTHOLIS COMPOSITUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Prepare 30 Gm.

Formula:

Storage.

Uses.

SUPPOSITORIES

Suppositories are solid bodies intended for insertion into the rectum, urethra, or vagina to produce medicinal action. A urethral suppository is also known under the name bougie, or bacillum, or cereolus. When intended for insertion into the nasal passages a similar shaped suppository is called a burginarium.

USES AND SHAPES FOR SUPPOSITORIES--The usual form of suppository is more or less conical, with a rounded apex. A variety of shapes is suggested. The smaller are for rectal use and the Pharmacopoeia directs that the adult rectal suppository shall weigh about 2 Gm. The infant rectal suppository is usually about one-half this weight. The larger more or less globular form represents vaginal suppositories. The official weight of these is 5 Gm. The pencil-shaped suppositories represent urethral types, which are to weigh about 2 Gm. and be 7 cm. ($2\frac{1}{2}$ inches) long for female use, or weigh about 4 Gm. and measure 14 cm. (5 inches) if for a male urethral suppository.

VEHICLES FOR SUPPOSITORIES--Three types of suppositories, with respect to the vehicle or base used, are recognized: First, those prepared with oil of theobroma or cacao butter (more commonly called cocoa butter) as the diluent and vehicle, and which quickly melt to an oily fluid at the temperature of the body. The second type is prepared with a mixture of equal parts of glycerin and gelatin, known as glycerinated gelatin as the diluent and vehicle. This type of suppositories does not melt at the body temperature but slowly dissolves in the secretions of the mucous membrane. They are usually employed to provide a continuous medicating or germicidal action. The third type represented by glycerin suppositories, or soap suppositories shaped from castile soap is not expected to melt or dissolve but to perform its function largely mechanically, producing some irritation. Their chief value is as a stimulation to peristalsis, through their presence in the rectum and they are largely used for small children to avoid the use of a laxative.

Oil of theobroma is an ideal vehicle or base for suppositories intended to melt when inserted into the rectum or other body cavity. It is a bland, non-irritating oil, pressed from ground cacao beans, and possessing the fatty substance, to within a few degrees of the body temperature, when it readily melts to a liquid, without passing through an appreciable softening stage. The melting point of oil of theobroma is from 30° to 35° C. (86° to 95° F.).

It is rarely necessary to raise the melting point of cacao butter by the addition of wax, spermaceti, etc. except in the warmest summer weather, or when phenol, camphor, chloral hydrate, the volatile oils, or similar substances form the medicating ingredients.

OIL OF THEOBROMA SUPPOSITORIES

To prepare suppositories with oil of theobroma as the vehicle or base, three methods are available in most pharmacies. The

first is known as "hand made or rolled," the second, "molded," and the third, "machine made or pressed."

The details of these several processes follow:

ROLLED OR HAND MADE SUPPOSITORIES represent the simplest process, provided climate or weather conditions make it applicable. In warm countries or in hot summer weather one of the other methods should be used. This process possesses an advantage over the molding process in that no complications arise from the use of heat and no provision need be made for excess material, since the entire mass is divided into the desired number of suppositories.

The following general process may be employed:

The cacao butter is scraped or grated and usually kept on hand ready for use.

Take the prescribed quantity of the medicinal substance and a sufficient quantity of grated oil of theobroma. Reduce the medicating ingredients to a fine powder, or, if composed of extracts, soften them with water and rub until a smooth paste is formed; the correct amount of grated oil of theobroma is then added, and a mass resembling a pill mass is made by thoroughly incorporating the ingredients with a pestle, sometimes with the aid of a small amount of wool fat. When the mass has become plastic under the vigorous kneading of the pestle, it is quickly loosened from the mortar with a spatula, pressed into a roughly shaped mass in the center of the mortar and then transferred with the spatula, to the palm of the hand. By a quick rotary movement from the palm of the other hand, the mass is rolled to a ball which is immediately dropped to a pill tile. Here a suppository cylinder is formed by rolling the mass upon the tile with a flat board, partially aided by the palm of the hand, if weather conditions permit. The suppository pipe will frequently show a tendency to crack in the center, developing a hollow core. This is due to the fact that the mass has not been kneaded and softened sufficiently, with the result that the pressure of the roller board is not carried uniformly throughout the mass but is exerted primarily upon the surface only. The length of the cylinder usually corresponds to about four spaces on the pill tile for each suppository, thus making the piece, when cut, practically a finished suppository except for the sharpening of the point. When the cylinder has been cut into the proper number of pieces with a spatula, the conical shape is given it by rolling one end upon the tile with a spatula, or in some cases even by shaping it with the fingers, so as to produce a rounded point. With practice, excellent rolled suppositories can be made. This method has the substantial merit of requiring very little apparatus, but considerable skill is needed to produce suppositories equaling in finish those which are molded. In the various stages described above, the suppository mass may become tacky or sticky. A careful manipulator will be able to prevent this by the manner in which the mass is handled. However, if it does become sticky, the judicious use of a small amount of dusting powder such as talc or starch, will correct the condition. An excess of

dusting powder should never be used and it is not necessary to have it show upon a finished suppository if the proper technic is observed. Do not handle a mass continuously if it has a tendency to become sticky, but knead it and shape it by light, easy pressure from the fingers.

One of the most rapid and efficient methods for shaping the finished suppository, when the hand process is followed is roughly to point the cylindrical section, which has been cut for an individual suppository, and force it quickly and with considerable pressure, applied by the spatula, or a roller board, into a cold suppository mold which has been well dusted with talc. Remove each suppository and again dust the mold before shaping the next one.

Lycopodium is sometimes used as a dusting powder in the making of suppositories but any excess left on the suppository is believed to be irritating when inserted and its use has been largely discontinued.

MOLDED SUPPOSITORIES--The capacity of each mold in use at the prescription counter, in terms of oil of theobroma, must first be determined. This is done by molding plain oil of theobroma and weighing the suppositories. This weight should be recorded and used in calculating the formula for subsequent suppositories. Now calculate the amount of oil of theobroma required to make suppositories of the desired weight, taking into consideration the weight of the medicine to be incorporated, and also planning for enough additional medication and oil of theobroma for at least one extra suppository. This is necessary to provide for the waste in pouring the suppositories, some mass always sticking to the dipper and other excess portions being cut from the top of the mold.

The Density of Medication--If the medicinal substance has a density of approximately that of oil of theobroma, the weight of medication may replace an equal weight of the oil. If, however, the medication is heavier, it will replace a proportionally smaller amount of oil. For instance, lead acetate has a density of 2.5 as compared with oil of theobroma. If the suppositories were to carry 2 grains each, a dozen would require 24 grains. This is divided by 2.5, the comparative density of lead acetate, which indicates that 24 grains of this salt will replace only 9.6 grains of the oil, not 24 grains, and proportionally more oil of theobroma must be taken to provide sufficient diluent for 12 suppositories. It is always possible to determine the density of a medicinal substance, in relation to oil of theobroma, if the information is not available, by mixing the amount for one suppository with a little melted oil, pouring it into a suppository mold and carefully filling the mold with plain oil of theobroma. The cooled suppository is then weighed and the weight of the medication subtracted from it. This will indicate the amount of oil of theobroma used and from this data the density of the medication can be calculated.

Having finely powdered the medicinal ingredients, if vegetable drugs or chemicals, and having softened extracts when present,

weigh the total amount of oil of theobroma needed and melt it in a casserole with a gentle heat. A porcelain casserole is the best vessel in which to melt the oil of theobroma which must always be warmed on a water bath of luke-warm water. Incorporate the medicinal substances intimately with about an equal weight of the melted oil of theobroma on an ointment slab, using a spatula and, when uniformly mixed, transfer the uniform mixture to the remainder of the melted oil of theobroma, which has been cooled to the correct temperature, which is almost that of the solidifying point. Stir until all is again uniformly melted, avoiding all excess of heat, and pour at once.

Pouring the Mass--The melted mass should be poured into the chilled mold from the casserole, which is usually held in the right hand. It should be vigorously stirred with a spatula immediately before the pouring begins, indeed, when heavy powders are directed, the stirring must not cease during the pouring or the last suppositories will contain a larger proportion of the heavy powder than those which were first made. In pouring, each opening in the mold may be exactly and uniformly filled or the openings may all be overflowed so that the tops run together on the mold. In the latter case allow the mold to stand on the counter until the mass on top has solidified, then cut off the excess with a spatula. The molds are then placed on ice and when sufficiently hardened the suppository will be found to have contracted slightly so that light pressure on the base of each suppository will cause it to loosen in the mold and readily drop from the mold after it is opened, apply a quick, firm pressure with the thumb, first to the base, and, if this does not free it, try pressing the point. Never apply continued pressure. It will melt the suppository. It is also desirable to cool the thumb, by placing it on the ice for a moment, before giving the quick, firm pressure. The novice almost invariably makes the mistake of opening the divided molds too soon (before the limit of contraction is reached); the suppository sticks to the mold, and splitting ensues.

With the presence of an electric refrigerator in most pharmacies today, the suppository mold may conveniently and very satisfactorily be cooled in the freezing cabinet of the refrigerator. This not only guarantees a cold mold but the degree of coldness is such that it is not necessary to use a lubricant upon the mold, since the suppository mass contracts to such a degree that the suppositories can usually be emptied from the mold without the necessity of even opening it. Where a lubricant is used in the molds to facilitate the removal of the suppositories, lycopodium and also a 6 per cent solution of castile soap or of soft soap in 70 per cent alcohol are used. The soap solution is best applied by twisting cotton on a stick such as a throat applicator, and using just sufficient solution to moisten the walls of the mold. The alcohol must evaporate before pouring the mass. Lycopodium is considered by some to be objectionable because of its alleged irritation to mucous membrane.

The beginner often fails when starting with the fusion method due to the use of too much heat. When it is remembered that an oil of theobroma suppository mass melts at the temperature of the

body and that the least possible heat should be used, the dispenser soon learns to keep entirely away from a direct flame and use only a lukewarm water bath.

Many combinations are decomposed or separated from the base by overheating. This is notably the case with ichthammol or with mixtures of astringent drugs and vegetable extracts, such as lead acetate or tannic acid, with the extracts of opium, belladonna, stramonium, etc.

Ingredients Which Soften Oil of Theobroma--Suppositories containing chloral hydrate, phenol, or other substances which soften the vehicle, should have the melting point of the oil of theobroma slightly raised by the addition of from 10 to 15 per cent of spermaceti, but the melting point must not be above 37° C. (98.6° F.).

Other difficulties in molding suppositories are easily overcome by the exercise of judgment and knowledge of physical laws. A defect frequently seen in the finished cacao butter suppository is that the surface is not always perfectly smooth. This may arise from several causes. Sometimes ridges are seen traversing the suppository; these are usually produced by overcautiousness, the operator pausing in pouring the melted mass into the mold, then pouring in a little more, then pausing again, and so on. On removing the suppository, a ridge will be found at each spot where a pause was made. The remedy for this is to keep on pouring steadily when this part of the process is reached. Other defects are pitting, causing an imperfection in points of the suppositories. This pitting is usually caused by drops of water which have not been shaken out of the mold before pouring the melted mass. Still another defect is a depression in the center of the base of each suppository. This is due to not overflowing the molds so as to leave an excess of mass upon the top and it is intensified by pouring the mass when too warm. In all cases there should be little more mass than will fill the molds; after cooling, the excess may be cut off if desired. The most perfect suppositories, however, are those which have been poured slightly more than full, leaving a rounded top, but all must be uniform. As this is difficult it is usually the custom to cut off all bases even with the top of the mold, to make all suppositories alike.

If strong heat is used upon an extract mixture ready to be molded, water is evaporated, the extract separates in small masses, and like a broken emulsion, the mass is "cracked." The remedy is to pour it at once upon an ointment slab or tile, add a little water, and rub it until the original condition is regained. However, as has already been emphasized, the mass containing the medicating ingredients should not be heated directly. Heat should be applied only to the oil of theobroma.

GLYCERINATED GELATIN SUPPOSITORIES--The basic material from which these suppositories are made is official. They are used chiefly for vaginal suppositories and are mostly healing or germicidal. Boroglycerin, ichthammol, zinc oxide, and bismuth subnitrate

are typical forms of medication. They may be made by mixing the medicinal substance, if solid and soluble, in water or glycerin, or if a miscible liquid, with a little water, and adding sufficient glycerin to make the weight of the mixture one-half that of the finished mass; then thoroughly incorporate it with an equal weight of melted glycerinated gelatin, and pour it at once into suitable molds which have been greased with a small quantity of petrolatum. Cool the molds thoroughly before removing the suppositories. Molds for urethral suppositories should be warmed sufficiently before pouring the mass to facilitate the proper filling of the mold. Suppositories having a firmer consistence may be prepared by substituting mucilage of acacia for a portion of the water or glycerin.

If the medicinal substance is insoluble in water or glycerin, thoroughly levigate it in a warm mortar with a sufficient quantity of glycerin to make the weight of the mixture one-half that of the finished mass. Then thoroughly incorporate it with an equal weight of melted glycerinated gelatin, and pour it into suitable molds as above directed. With bulky powders about one-half of the glycerin may be replaced with water before levigation.

Glycerinated gelatin suppositories should be protected against the effects of heat, moisture, and dry air by keeping them in tightly closed containers in a cool place.

SUPPOSITORIA BOROGLYCERINI N.F. Suppositories of Boroglycerin.
(Supp. Boroglycerin.)

Glycerinated Gelatin.	20 Gm.
Glycerite of Boroglycerin.	15 Gm.
Glycerin.	<u>15 Gm.</u>

To make 12 (twelve) rectal suppositories.

Melt the glycerinated gelatin on a water bath, add the glycerite of boroglycerin and the glycerin, and mix well. Pour the mixture into well-oiled, slightly warmed molds of the required size and shape, and allow to stand until the suppositories are firm.

Storage--Keep and dispense the Suppositories in well-closed containers.

SUPPOSITORIA GLYCERINI U.S.P. Suppositories of Glycerin
(Supp. Glycerin.--GLYCERIN SUPPOSITORIES)

Glycerin.	92 Gm.
Sodium Stearate.	8 Gm.
Distilled Water.	<u>5 Gm.</u>

To make about. 30 rectal
suppositories.

Heat the glycerin in a porcelain dish on a water bath, to about 95° C., add the sodium stearate, and stir the mixture gently with a glass rod maintaining the specified temperature, until the sodium stearate is dissolved. Then add the distilled water, mix thoroughly, and immediately pour the hot liquid into suitable molds.

Remove the suppositories when they are completely cold and preserve them in tightly stoppered glass containers in a cool place.

NOTE--If preferred, the sodium stearate for Suppositories of Glycerin may be prepared during the making of the Suppositories by the direct reaction between stearic acid and sodium bicarbonate, sodium carbonate, or sodium hydroxide, these being taken in correct proportion.

A typical formula is that of the U.S.P. X which is as follows:

Glycerin.	80 Gm.
Monohydrated Sodium Carbonate.	2 Gm.
Stearic Acid.	8 Gm.
Water.	10 cc.
To make about.	30 sup- positories.

Dissolve the monohydrated sodium carbonate in the water and add it to the glycerin contained in a suitable vessel, placed in a water bath in such a way that the vessel is well immersed in the boiling water and its contents protected as much as possible from the steam of the bath. Add the stearic acid and heat the mixture for fifteen minutes or until the carbon dioxide ceases to be evolved, and the liquid is clear. Then pour the melted mass into suitable molds, remove the suppositories when they are completely cold, and preserve them in tightly stoppered glass vessels in a cool place.

OLEUM THEOBROMATIS U.S.P. Theobroma Oil
(Ol. Theobrom.--Cacao Butter; Cocoa Butter; Oil of Theobroma)

The fat obtained from the roasted seed of Theobroma Cacao Linne (Fam. Sterculiaceae).

PREPARATION--This is made by grinding the kernels of the "chocolate bean" and expressing in powerful, horizontal hydraulic presses. The yield is about 40 per cent. It has also been prepared by dissolving the oil from the unroasted beans by the use of a volatile solvent. This oil, however, is not official in the U.S.P.

Chemically it is a mixture of stearin, palmitin, olein, and linolein, and, owing to its low fusing point, and its property of becoming solid at a temperature just below the fusing point, it is valuable in pharmacy for making suppositories.

DESCRIPTION AND PHYSICAL PROPERTIES--A yellowish-white solid, having a faint, agreeable odor, and a bland, chocolate-like taste.

Theobroma Oil is usually brittle at temperatures below 25° C.

Theobroma Oil is slightly soluble in alcohol; soluble in boiling dehydrated alcohol; freely soluble in ether, in chloroform,

in petroleum benzin, or in benzene.

TESTS FOR IDENTITY AND PURITY--Specific gravity: 0.858 to 0.864 at 100° C.

Theobroma Oil melts between 30° and 35° C.

Saponification value: not less than 188 and not more than 195.

Iodine value: not less than 35 and not more than 40.

Solidification point of the fatty acids: not less than 45° C and not more than 50° C.

N. F. Preparation--Syrupus Cacao Praeparati.

STORAGE--Preserve Theobroma Oil in a cool place.

USES--In addition to its use as a vehicle for suppositories, cacao butter is an excellent emollient application to the skin when inflamed; it also is used in various skin creams especially the so-called "skin foods." It is also used in massage. Its adulterants are coconut oil and palm nut oil stearins; also stearin and tallow.

Define Suppositories:

Name three bases usually employed for suppositories.

Name three forms of suppositories and give the approximate weight of each.

SUPPOSITORIA GLYCERINI

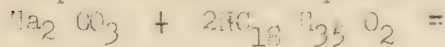
O.E.T.

Syn.

Prepare 12 suppositories (use U.S.P. X formula)

Formula:

Complete chemical equation:



Storage.

Use.

Prepare by hand 6 Tannic acid Suppositories and 6 Iodoform Suppositories (Remington Page 517).

OIL OF THEOBROMA SUPPOSITORIES.

Prepare 12.

Medicinal Substance--Iodoform.

Formula:

How may the melting point of this preparation be altered?

What two forms of Oil of Theobroma are on the Supply Table and how do they differ?

PHENOL LIQUEFACTUM U.S. Liquefied Phenol
(Phenol Liq.--Liquefied Carbolic Acid)

Phenol maintained in the liquid condition by the presence of 10 per cent of distilled water. It contains not less than 88 per cent of C_6H_5OH .

PHENOL, a convenient quantity,
DISTILLED WATER, a sufficient quantity.

Liquefy the phenol by placing the unstoppered container in a water bath and apply heat gradually until it is melted. Transfer the liquid to a tared vessel, weigh, and add 1 Gm. of distilled water for each 9 Gm. of phenol and mix thoroughly.

On standing, liquefied phenol becomes pink or red in color. It is claimed that the immersion of a few strands of wool yarn will remove the color, the wool becoming dyed, and the phenol restored to its original appearance.

DESCRIPTION AND PHYSICAL PROPERTIES--A colorless liquid, which may develop a red tint upon aging. It has a characteristic, somewhat aromatic odor. When undiluted it cauterizes and whitens the skin and mucous membrane.

Liquefied Phenol is miscible with alcohol, ether, and with glycerin.

A mixture of Liquefied Phenol and an equal amount of glycerin is miscible with water.

Note--When Phenol is to be mixed with a fixed oil, liquid petrolatum, or petrolatum, use melted crystalline Phenol instead of Liquefied Phenol.

N.F. Preparations--Aqua Phenolata; Liquor Iodi Phenolatus; Liquor Sodii Boratis Compositus.

Storage--Preserve in well-closed containers and protected from light.

Uses--Liquefied phenol was introduced into the Pharmacopoeia to furnish a uniform and convenient method of using phenol in a concentrated liquid form. The practice of adding 10 per cent of water to crystallized phenol has long been followed, this liquid being often more convenient for compounding prescriptions than the crystals. In using it, allowance must, of course, be made for the presence of 10 per cent of water. The dose is 0.06 cc.

PHENOL LIQUEFACTUM

O.E.T. U.S.P. or N.F.

Syn. Abbr.

Definition:

Prepare 10 Gm.

Formula:

Explain the "note" under this preparation.

Uses and doses.

Storage.

Description and physical properties.

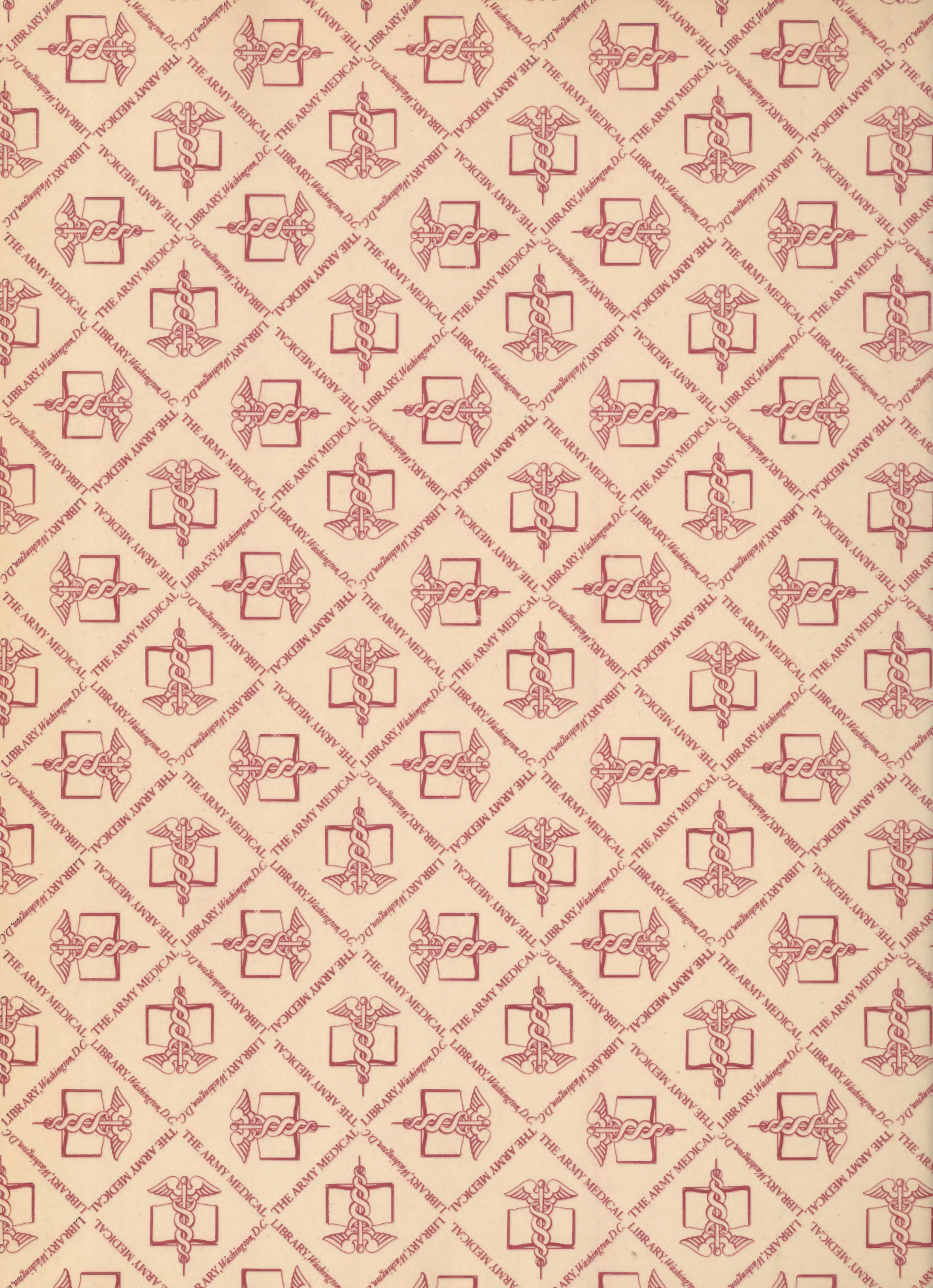
SCOTTS SOLUTION

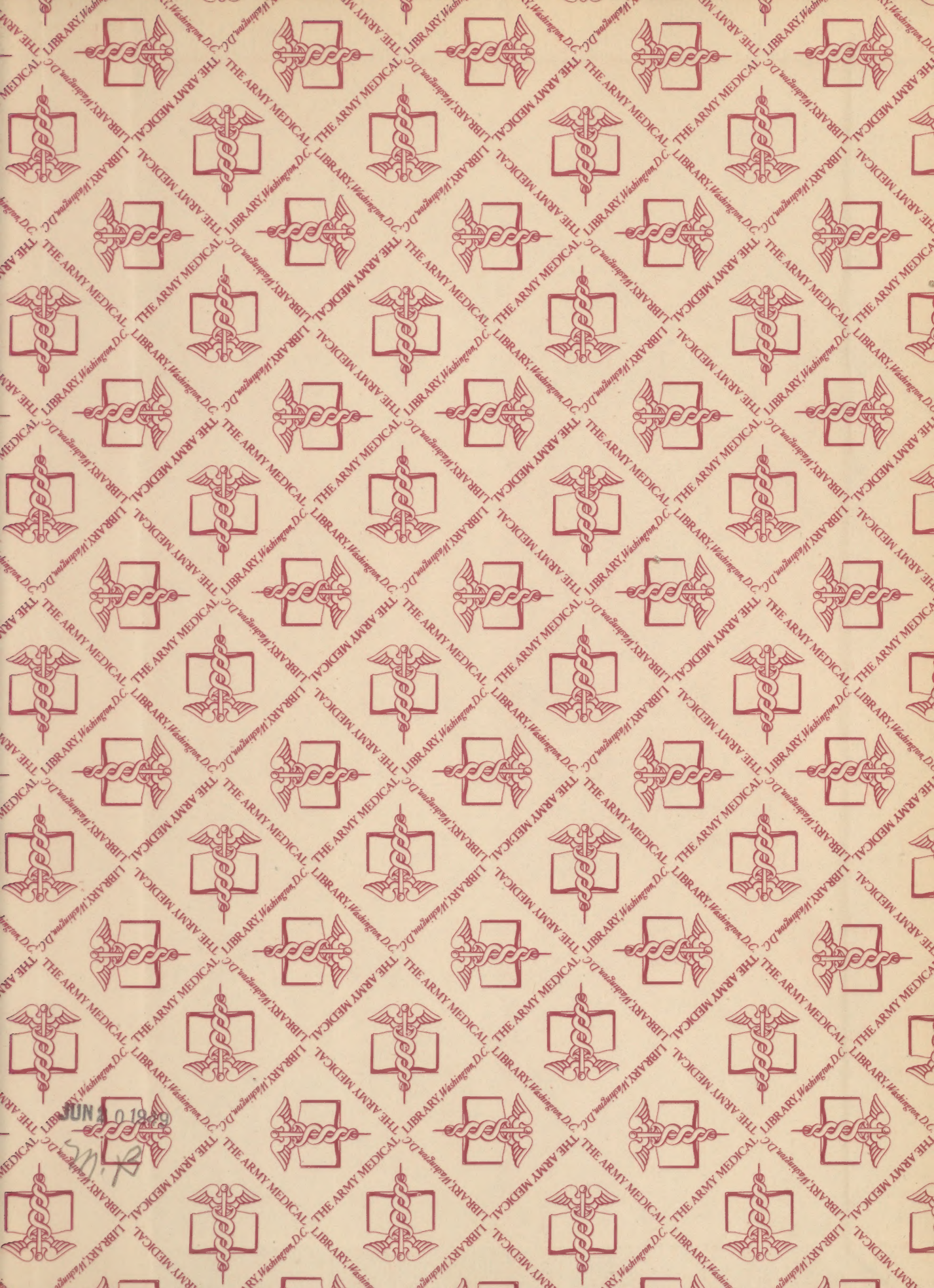
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In the army Scotts Solution has gained acceptance as an antiseptic for external application for the treatment of various skin disorders.

Mercurochrome	4,000
Distilled Water	56,000
Ethyl Alcohol 95%	58,000
Acetone	20,000

Dissolve the Mercurochrome in the distilled water. Mix the Acetone and alcohol to this mixture with constant stirring. Let stand for half an hour and filter if necessary.





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